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DECEMBER 1989

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 1990.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

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05 WATER QUALITY MANAGEMENT AND PROTECTION

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07 RESOURCES DATA

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08 ENGINEERING WORKS

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

SURVEY OF AGROMETEOROLOGICAL DISASTERS IN SOUTH CHINA.
Guangxi Agricultural Coll., Nanning (China). Dept. of Agrometeorology.
For primary bibliographic entry see Field 2B.
W89-12331

TESTING A THEORETICAL CLIMATE-SOIL-LEAF AREA HYDROLOGIC EQUILIBRIUM OF FORESTS USING SATELLITE DATA AND ECOSYSTEM SIMULATION.
Montana Univ., Missoula. School of Forestry.
For primary bibliographic entry see Field 2I.
W89-12339

MODELING CLIMATE CHANGE: AN ASSESSMENT OF SEA ICE AND SURFACE ALBEDO FEEDBACKS.
Meteorological Office, Bracknell (England). Dynamical Climatology Branch.
W. J. Ingram, C. A. Wilson, and J. F. B. Mitchell.
Journal of Geophysical Research (D) Atmospheres JGRDE3, Vol. 94, No. 6, p 8609-8622, June 20, 1989. 6 fig, 5 tab, 28 ref, append.

Descriptors: *Model studies, *Simulation, *Sea ice, *Albedo, *Climatology, Feedback, Carbon dioxide, Performance evaluation, Mathematical equations, Optical properties, Mathematical models, Statistics, Errors, Clouds.

The net strength of the sea ice and surface albedo feedbacks in simulations of climate change has been estimated for several general circulation model (GCMs) using a variety of methods. Several methods have been applied to quantify the feedback in a single CO2-doubling experiment with the United Kingdom Meteorological Office GCM. Different methods give values differing by up to a factor of 2 and apparently estimate different equations. An unbiased comparison of models is made using consistent methods and an attempt is made to explain the differences in model sensitivity in terms of control climate and parameterization. Comparing the standard experiment to a parallel experiment using prescribed sea ice extents allows examination of the feedback as it actually operates in the model. The importance of cloud is emphasized, both in shielding surface albedo changes and so reducing their effect, and in providing its own contribution to planetary albedo changes. Statistical methods are used to examine the relationship between surface albedo changes, which are given directly by the surface heat balance and albedo parameterization, and planetary albedo changes, which incorporate the effects of clouds and determine the net feedback. Estimates of the magnitude of the feedback in various GCMs vary from 0.16 to 0.7 W/sq m/K, with the highest value exaggerated by the method of analysis. It is concluded that care is needed in quantifying these feedbacks and that previously published numbers are not all comparable. The feedbacks in two of the GCMs are exaggerated by unrealistically extensive sea ice, but the smaller values given by other GCMs may still be unrealistic, because of uncertainties in the treatment of clouds. (Author's abstract)
W89-13119

WATER RESOURCES RESEARCH NEEDS IN THE ARABIAN GULF AREA.
Kuwait Inst. for Scientific Research, Safat. Environmental and Earth Sciences Div.
L. Hamdan.
Desalination DSLNAH, Vol. 72, No. 1/2, p 3-7, Apr/May 1989.

Descriptors: *Persian Gulf, *Natural resources, *Water resources development, *Research priorities, *Water supply development, *Regional development, Seawater, Desalination, Groundwater depletion, Wastewater treatment, Aquifer management, Water distribution, Water use efficiency, Water costs, Future planning, Data collections, Arid-zone hydrology.

The scarcity of natural sources of usable water in the arid area of the Arabian Gulf has continued to impose important limitations on the national development of the Gulf Cooperation Council countries (Kuwait, Saudi Arabia, Oman, Qatar, Bahrain, and the United Arab Emirates). The cost of seawater desalination remains high; groundwater extractions often exceed the natural replenishment; and treated wastewater is still largely under-utilized. Research is necessary to alleviate these constraints and contribute to securing water supplies sources needed to sustain the development and growth of this region. Priority goals of this research which are considered feasible include preservation and protection of aquifers; improving water distribution and use efficiency; reducing the cost of water production; securing supply sources to meet future water demands; and development of centralized national data banks and trained national cadres in water resources science and technology. (Fish-PTT)
W89-13137

DAILY RAINFALL-RUNOFF MODEL WITH THREE PARAMETERS (UN MODELE PLUIE-DEBIT JOURNALIER A TROIS PARAMETRES).
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France). Section Hydrologie.
C. Michel.
Houille Blanche HOBLAB, No. 2, p 113-121, 1989. 9 fig, 2 ref. English summary.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Mathematical models, *Computer programs, Simulation.

An attempt was made to develop a simulation model of rainfall-runoff that would give reasonable results by using the simplest possible representation of rainfall-runoff, based on a very small number of parameters. The research was based on a model called GR3, which belongs to the general class of models for reservoirs, and is especially based on the CREC model developed in 1969. Basins on which snow plays an important role were excluded. The model developed is based only on parameters which can be determined by gaging. It is easy to use, the uncertainties are minimal, and it can characterize a basin using only three parameters. (Peters-PTT)
W89-13189

HYDROLOGIC CYCLE: TURNOVER, DISTRIBUTION, AND UTILIZATION OF WATER.
Nottingham Univ. (England).
F. Franks.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 29-49, 4 tab, 5 fig, 8 ref.

Descriptors: *Hydrologic cycle, *Groundwater, *Physiological ecology, *Water management, *Water conservation, Plant physiology, Animal physiology, Metabolism, Climates, Precipitation, Salt tolerance, Habitats, Water transport, Chemical properties.

The continuous self-renewal of the world's freshwater supplies through the hydrological cycle takes place at such a rate that there is no danger of any future global water shortage. Also, groundwater is increasing in importance as a supply source: less than 3 per cent of the world's available freshwater occurs in streams and lakes. Because of spatial and temporal fluctuations in the levels of precipitation, local shortages will persist until some measure of climatic control is developed. This is not likely until a better understanding can be achieved of the complex relationships between meteorology, geology, and agriculture. Informed water management practices can do much to enhance the utilization of semi-arid lands, especially where the political and sociological conditions do not militate against such procedures. At the level of the individual organism, and even the single cell, water relationships in plants and animals are largely unexplored. Knowledge of the quantities of water which take part in metabolic reactions provides information about the scale of water transport within the total organism. For example, to supply cells with enough oxygen for their daily combustion of glucose the heart has to pump 7000 L of blood around the vascular system. Several organs are implicated in maintaining the physiological water balance and quality in organisms. Although plants and animals whose natural habitat is water do not have some of the problems associated with water conservation and purification, the limited supply and slow diffusion of oxygen makes breathing difficult and, for marine organisms, metabolic energy resources also are devoted to maintaining the body fluids at the correct osmotic concentrations. The relationships between growth, ion uptake, and accumulation, and the importance of these processes for salt tolerance, are still unclear, but the increasing losses of arable land due to secondary salination (induced by irrigation) should provide some urgency to studies of salt tolerance. (See also W89-13208) (Hammond-PTT)
W89-13209

HISTORY OF THE HYDROGRAPHY OF HUNGARY AND THE CARPATHIAN BASIN DETERMINED BY LARGE-SCALE TECTONICS.
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 2J.
W89-13310

LONG-TERM RECONSTRUCTION AND ANALYSIS OF WHITE RIVER STREAMFLOW.
Arkansas Univ., Fayetteville. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W89-13403

LATE QUATERNARY PALEOHYDROLOGY OF THE EASTERN MOJAVE RIVER DRAINAGE, SOUTHERN CALIFORNIA: QUANTITATIVE ASSESSMENT OF THE LATE QUATERNARY HYDROLOGIC CYCLE IN LARGE ARID WATERSHEDS.
New Mexico Univ., Albuquerque. Dept. of Geology.
S. G. Wells, R. Y. Anderson, L. D. McFadden, W. J. Brown, and Y. Enzel.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-217582/AS. Price codes: A13 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 242, May 1989. 253p, 72 fig, 16 tab, 4 maps, 285 ref. USGS Contract 14-08-0001-G1312.

Descriptors: *Floods, *Paleohydrology, Paleoclimatology, Lake basins, Geology, Mojave River, Climatic data, California, Lake Mojave, Model studies, Hydrologic regimes, River drainage, Arid watersheds.

Historic climatic/hydrologic records and the latest Quaternary record from a climatically sensitive lake basin provide a unique opportunity for determining the variability of climatic regimes and hydrologic responses over the past 20,000 years within the Mojave River watershed. During the twentieth century, several short-term lakes formed in the playas at the terminus of the Mojave River in response to precipitation/flood runoff thresholds in the Transverse Ranges, 200 km away from the terminal lakes. Climatic forcing during lake-forming years, especially 1916, 1938, 1969, and 1978, approximate some of the climatic conditions between 22,000 and 8,700 years ago. Modeling results of climatic conditions suggest that significant increases in storm frequency and related moisture in the Transverse Ranges, and an order of magnitude increase in frequency of lake-building flood events along the Mojave River are required to maintain lake levels observed in the geologic record in the terminal basins. Data from 13 cores from Lake Mojave reveal strong millennia climatic oscillations, expressed as high and low lake stands, which developed in response to large scale, oceanic-atmospheric phenomenon during the latest Quaternary. The last two climatic cycles represent Pleistocene to Holocene climate conditions, from 13,700 to 8,700 years ago, and appear to correlate with significant changes in vegetation throughout

the Mojave Desert. Shorter-term cycles occurred approximately 390 and 3,620 years ago, during known times of glacial advances throughout the world. Both of these short-term and long-term cycles also appear to correlate to increased oceanic sedimentation rates, landslide failures, erosion and sediment yield, fill-terrace information and alluvial-fan building within southern California. Enhanced understanding of oceanic-atmospheric conditions producing these hydrologic events will enhance the future performance of the Mojave River hydrologic system. (Wells-NM U)
W89-13404

2B. Precipitation

ACID PRECIPITATION EFFECTS ON GROWTH AND YIELD RESPONSES OF TWENTY SOYBEAN AND TWELVE SNAP BEAN CULTIVARS.
North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Plant Science and Technology.
For primary bibliographic entry see Field 5C.
W89-12174

CHEMISTRY OF RAINWATER AND CLOUD WATER AT REMOTE SITES IN ALASKA AND OREGON.
Pacific Northwest Forest and Range Experiment Station, Juneau, AK. Forestry Sciences Lab.
For primary bibliographic entry see Field 5B.
W89-12175

IMPROVING THE DETECTION OF AGRICULTURAL DROUGHT: A CASE STUDY OF ILLINOIS CORN PRODUCTION.
Illinois State Water Survey Div., Champaign. Climatology and Meteorology Section.
For primary bibliographic entry see Field 7B.
W89-12329

SURVEY OF AGROMETEOROLOGICAL DISASTERS IN SOUTH CHINA.
Guangxi Agricultural Coll., Nanning (China). Dept. of Agrometeorology.
S. Xiang, and J. F. Griffiths.
Agricultural and Forest Meteorology AFMEEB, Vol. 43, No. 3/4, p 261-276, September 1988. 7 fig, 9 tab, 13 ref.

Descriptors: *Agricultural hydrology, *Disasters, *Meteorology, *China, *Rainfall, *Precipitation, *Rainfall-runoff relationships, *Climatology, Drought, Monsoons, Tropical regions, Rice, Floods, Saturation, Rainfall distribution, Typhoons, Weather patterns, Hail, Waterlogging, Tropic zone, Subtropic zone, Seedlings.

The climatic features of tropical and sub-tropical provinces of China are reviewed. Warmth and abundant rainfall allow for intensive agricultural development. However, the region does suffer weather situations that are devastating to crops. A number of these, such as drought, flooding, typhoons, cold waves and hail are discussed, and their climatology is presented. Definitions are given of drought, flood-waterlogging, cold-wave and cold-dews wind, as these are used in China. The latter phenomenon is a fall season condition with low temperature and either dry and windy, or cloudy and drizzly, which is very destructive of late season rice. South China is one of the rainiest regions in China. However, since it is affected by the monsoon regime, the distribution of rainfall is uneven both in time and space. Also, the year-to-year rainfall variations is large. These conditions lead to South China being susceptible to drought and waterlogging. The district with the most damaging of fall droughts are the northern part of Guangdong and Guangxi. Waterlogging is generally caused by heavy continuous rain, which occurs very often in South China, mainly due to its proximity to the tropical ocean. The waterlogging rains are mainly associated with fronts and typhoons. At this time, there is a high probability of flood-waterlogging occurring the middle and lower reaches of the major rivers of South China. Dry, cold weather, partially responsible for seedling rot of early season rice, occurs mainly in February and March, and results primarily from scant sunshine and strong wind; the cold-dews wind has a great influence on heading-flowering of late season rice and often leads to increase in the empty grain rate and a reduction in or loss of yield. (Friedmann-PTT)
W89-12331

MEASUREMENT AND MODELING OF RAINFALL INTERCEPTION BY AMAZONIAN RAIN FOREST.
Institute of Hydrology, Wallingford (England).
C. R. Lloyd, J. H. C. Gash, W. J. Shuttleworth, and A. D. O. Marques F.
Agricultural and Forest Meteorology AFMEEB, Vol. 43, No. 3/4, p 277-294, September 1988. 4 fig, 2 tab, 23 ref, append.

Descriptors: *Interception, *Amazon River, *Model studies, *Evaporation, *Rainfall, *Precipitation, *Rain forests, *Throughfall, *Meteorological data collection, Computer models, Amazon Rain Forest, Trees, Canopy, Drying, Interception loss, Performance evaluation.

Measurements of the evaporation of rainfall intercepted by Amazonian rain forest were compared with estimates made by two models, the Rutter model and Gash's analytical model, applied to meteorological measurements made with automatic weather stations mounted above the forest. The Rutter model is essentially a numerical computer model that calculates a running balance of the depth of water on the forest canopy and tree trunks. The model requires the following state parameters: canopy storage capacity (the depth of water left on the canopy in conditions of zero evaporation, when rain and throughfall have ceased); free throughfall coefficient (the proportion of rain that falls to the ground without striking the canopy); trunk water capacity, and proportion of rain diverted to the trunks. Gash's analytical model considers rainfall to occur in a series of discrete storms, each of which comprises a period of wetting up, a period of saturation and a period of drying out. The model, essentially a simplification of the Rutter model, assumes the canopy to have sufficient time to dry between storms. Neither of the model estimates of interception loss was significantly different from measured interception loss, which amounted to 8.9% of the measured rainfall. It is concluded that the performance of both models, using defined storage capacities, was adequate and it does not seem justified, at this stage, to introduce the additional complexity of dynamic storage capacities. (Friedmann-PTT)
W89-12332

MONITORING THE WEATHER AT FIVE WINTER WHEAT EXPERIMENTAL FIELD SITES.
Nebraska Univ.-Lincoln. Center for Agricultural Meteorology and Climatology.
K. G. Hubbard, B. L. Blad, S. B. Verma, A. Bauer, and J. L. Hatfield.
Agricultural and Forest Meteorology AFMEEB, Vol. 44, No. 2, p 117-130, December 1988. 9 fig, 3 tab, 14 ref. NSF Grant ATM-8417995.

Descriptors: *Monitoring, *Experimental farms, *Weather data collections, *Meteorological data collection, *Wheat, Precipitation, Temperature, Rainfall, Wind, Soil temperature, Climate, Climatology, Vapor pressure, Hydrologic cycle, Agricultural hydrology, Solar radiation.

Weather monitoring equipment was set up at 5 winter wheat experimental field sites ranging from Lethbridge, Alberta, Canada, to Lubbock, Texas. Uniform weather-measurement techniques were employed at all locations for the following weather variables: wind speed and direction; solar radiation; air temperature and relative humidity; soil temperature and precipitation. Weather data for the Nebraska and Kansas locations were automatically retrieved via daily computer telecommunication. Data from the remaining locations were retrieved at the end of each growing season. Data from 2 growing seasons show wide differences in the environmental conditions among the study locations. Near-real-time data collection required less quality control because the daily eavesdropping on the station resulted in less sensor down time. A preliminary monthly assessment of the temperature data collected showed no excursion from normal at any of the locations. Precipitation data on a monthly basis varied less than 10% of normal to over 200% above normal. Both variables measured at the study sites agreed well with nearby official stations. A comparison of solar radiation, vapor-pressure deficit, wind run and soil temperature data from site to site shows obvious differences in the growth environments. These differences were large enough to be considered important factors and deserve further study to determine if they may have affected the experimental outcome from site to site. (See also W89-12333) (Friedmann-PTT)
W89-12334

ESTIMATING THE AGRICULTURAL RISKS OF TROPICAL RAINFALL.
S. Nieuwolt.
Agricultural and Forest Meteorology AFMEEB, Vol. 45, No. 3/4, p 251-263, March 1989. 6 fig, 4 tab, 18 ref.

Descriptors: *Rainfall, *Precipitation, *Rainfall impact, *Tropical regions, Rainfall intensity, Drought, Meteorological data collection, Monsoons, Climate, Estimating, Risk assessment, Hydrologic budget.

Some objective methods used to estimate the effects of rainfall on agriculture in the tropics, e.g., in water balances, usefulness of rainfall, etc., are reviewed. Most tropical rainfall is characterized by irregularity and high intensity. This causes danger to agriculture from short droughts and spells of heavy rainfall. Both are often concealed by monthly rainfall totals. The D-index, based on daily data, estimates the probability of droughts of a specified minimum duration. The W-index gives the mean amount received during very wet spells of 1-5 days. Both indices can be computed from relatively short series of records. The indices show large differences between four stations in different parts of the tropics. Monsoon rainfall is marked by higher incidences of dry spells and a larger proportion of the total is received during wet spells than in tropical rainfall of other origin. (Author's abstract)
W89-12341

RAINFALL PATTERNS IN RELATION TO PEAT EXTRACTION AND SILAGE MAKING.
University Coll., Dublin (Ireland).
S. M. Ward.
Agricultural and Forest Meteorology AFMEEB, Vol. 46, No. 1/2, p 173-178, April 1989. 6 fig, 9 ref.

Descriptors: *Weather patterns, *Agricultural engineering, *Rainfall, *Peat, *Silage, *Soil moisture deficiency, Soil water, Precipitation, Seasonal variation, Climate, Probabilistic process, Agricultural hydrology, Drought, Ireland, Wilting.

An analysis of the occurrence of 2-day and 4-dry-day periods during the summer months is presented, and the frequency of occurrence of such periods is linked to certain operations in Ireland. For example, the number of Peco milled peat harvests is associated with the occurrence of 4-dry-day periods, while silage wilting is likely to be dependent upon the number of 2-dry-day periods. Probability levels for the occurrence of such dry spells are given and the required mechanization system power rating for wilted silage is calculated, e.g., a farmer with 30 ha of first-cut wilted silage requires an 88 kW rig, while the corresponding figure for a farmer with 50 ha is 152 kW. (Author's abstract)
W89-12345

DISTRIBUTION OF ATMOSPHERIC POLYCHLORINATED BIPHENYL CONGENERS BETWEEN VAPOR PHASE, AEROSOLS, AND RAIN.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.

For primary bibliographic entry see Field 5B.
W89-12381

STUDY OF CLIMATIC VARIABILITY IN NIGERIA BASED ON THE ONSET, RETREAT, AND LENGTH OF THE RAINY SEASON.
Ilorin Univ. (Nigeria). Dept. of Geography.
O. J. Olaniran, and G. N. Sumner.
International Journal of Climatology IJCLEU, Vol. 9, No. 3, p 253-269, May/June 1989. 4 fig, 6 tab, 46 ref.

Descriptors: *Weather patterns, *Climates, *Climatology, *Nigeria, *Rainfall, *Precipitation, Meteorological data collection, Rain, Rainfall distribution, Seasonal variation, Monsoons, Climatic zones.

The long-term variability of rainfall conditions in Nigeria in terms of the onset, retreat, and length of the rainy season has been analyzed, using pentad data for the period 1919-1985. Data were grouped into four areas, arranged in a south-north transect; the Coastal, Guinea-Savanna, Midland and Sahelian Zones. The series for retreat of rainfall showed evidence for quasi-triennial and quasi-6-year oscillations, while that for rainy season length displayed quasi-biennial and quasi-triennial oscillations. No consistent spectral peaks emerged for changes in the date of onset of the rainy season. There is spatial coherence in variation in the date of the retreat of rainfall over the whole country, while for the date of onset, of the season, spatial coherence is limited to southern Nigeria (Coastal and Guinea-Savanna Zones). Northern Nigeria (Midland and Sahelian Zones) and southern Nigeria (Coastal and Guinea-Savanna) emerge as distinct areas in terms of spatial coherence in the variation of the length of the rainy season. There is also evidence for a secular change in the date of the retreat of rainfall for the whole country during the period 1939-1985, and in the date of onset of rainfall for southern Nigeria for 1968-1985. (Author's abstract)
W89-12608

CLASSIFICATION OF THE CLIMATE OF ENGLAND AND WALES BASED ON AGROCLIMATIC DATA.
Institute of Terrestrial Ecology, Edinburgh (Scotland).
E. J. White, and A. H. Perry.
International Journal of Climatology IJCLEU, Vol. 9, No. 3, p 271-291, May/June 1989. 13 fig, 5 tab, 33 ref.

Descriptors: *Transpiration, *Soil-water-plant relationships, *Climates, *Climatology, *Rainfall, *Soil water, *Soil moisture deficiency, *England, *Wales, Seasonal variation, Precipitation, Agricultural hydrology, Principal component analysis, Cluster analysis, Comparison studies, Drought, Statistical analysis, Plant growth, Wind, Cloud cover, Soil types, Limiting factors.

Classifications of the climate of England and Wales, based on documented agroclimatic data, are described. A principal component analysis was carried out on these data in order to simplify them by removing inessentials. This showed that most variation in the variables was associated with maximum soil moisture deficit in summer and effective transpiration, both important for plant response. Six methods of cluster analysis were then used, two of which, further neighbor and minimum variance, were selected for comparison. The groups into which areas were classified were based on the two climatological variables. First, there is considerable variation in the ratio of soil moisture deficit to effective transpiration from 3.3 in the southeast group (of the minimum variance method) to 49 in the Welsh Uplands. The hot dry summers of the southeast are associated with a long period of grass drought, during which there is no effective transpiration and a high soil moisture deficit. On the other hand, in the Welsh Uplands, a warm rainy summer produces high effective transpiration and lower soil moisture deficit. Second, in terms of plant response, it seems that areas such as the Oceanic group, southeast Wales and Dartmoor, with highest effective transpiration, can produce the greatest growth through a season. Other factors such as wind exposure, persistence of cloud cover and soil type may limit growth. Comparing the present classification system with others in the literature, there is general similarity with different basic variables. Others have used a measure of temperature, warmth of duration of growing season, and rainfall. Others have excluded seasonality in the moisture regime. (Friedmann-PTT)
W89-12609

SUMMER SNOWFALLS OVER THE MOUNT OLYMPUS AREA.
Thessaloniki Univ., Salonika (Greece). Dept. of Meteorology and Climatology.
For primary bibliographic entry see Field 2C.
W89-12610

HALE CYCLE AND INDIAN DROUGHT AND FLOOD AREA INDEXES.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
A. R. Rao, and G. H. Yu.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 315-333, June 1989. 7 fig, 7 tab, 11 ref.

Descriptors: *Solar radiation, *India, *Climatology, *Drought, *Flood frequency, Flood recurrence interval, Flood forecasting, *Climates, Model studies, Statistical models, Statistical methods, Sunspots, Weather forecasting.

The Indian drought and flood area indexes (DAI and FAI, respectively) have been suggested to be related to the Hale cycle of sunspot numbers. The dependence between sunspot numbers, DAI, and FAI series were previously studied using spectral, cross-spectral and dial analyses. The inference problems and the lack of dependability of results associated with cross-spectral analysis of autocorrelated time series are well known. Consequently, in this study, the relationships between sunspot number, FAI, and DAI are studied by using more accurate methods of investigation of causal connections between time series and the results are reported. Univariate ARMA models are fitted to sunspot number, double sunspot cycle, DAI, and FAI series and these models are validated. The cross-correlation properties of residuals from these models are studied. Statistical tests are used to investigate the causal connections between sunspot numbers and DAI and FAI series. The results indicate that there is no significant relationship between sunspot number and FAI series. There is a consistent, statistically significantly relationship between sunspot number and mild and moderate DAI series. However, these relationships are not strong enough to be used in forecasting droughts. (Author's abstract)
W89-12629

SIMULATION MODELS OF SEQUENCES OF DRY AND WET DAYS.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
J. W. Delleur, T. J. Chang, and M. L. Kavvas.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 344-357, June 1989. 6 fig, 1 tab, 17 ref. USDI Grant OWRT-B-112-Ind.

Descriptors: *Weather patterns, *Model studies, *Statistical models, *Simulation, *Rainfall, *Precipitation, Probabilistic process, Flood forecasting, Weather, Indiana, Drought, Agricultural hydrology, Irrigation practices.

A new statistical model has been developed for the simulation of sequences of dry and wet days. The model is based on the discrete autoregressive-moving average (DARMA) family of stochastic processes, which includes the Markov chain as a particular case. The model building is based on a three-step procedure consisting of identification, estimation, and model selection. The model identification and parameter estimation are based on the best fit of the autocorrelation function, while the selection of the optimum model is based on the best reproduction of the probability distribution function of the lengths of the runs of dry days and wet days. The model has thus the property of reproducing the persistence of dry spells and wet spells which are important in the evaluation and forecast of droughts and floods. Excellent results were obtained with rainfall data from Indiana, which indicate that the models are useful for scheduling irrigation of crops in the Central United States and possibly elsewhere. (Author's abstract)
W89-12631

RESONANCE INTERACTIONS OF WATER CLUSTERS AND DROPLETS AND A MODEL OF CLOUD FORMATION (REZONANCKOE VZAIMODEISTVIE KLASTEROV I KAPELEK VODY I MODEL' OBLACHNYKH OBRAZOVANII).
Akademiya Nauk Gruzinskoi SSR, Tiflis. Inst. Kibernetiki.
M. E. Perelman, and I. I. Badinov.
Soobshcheniia Akademii Nauk Gruzinskoi SSR SAKNAH, Vol 131, No 2, p 301-304, August 1988. 7 fig, 12 ref. English summary.

Descriptors: *Cloud liquid water, *Clouds, *Cloud physics, Atmospheric physics, Fluid drops.

Such properties of water clouds as their water bearing capacity, the narrowness of the droplet size spectra, and the relative stability of the apparent chaotic ensemble of clusters and droplets can be accounted for by the exchange of resonance quanta (50 mem) which are generated by self-diffusion of molecules in drops and by the latent energy liberated during the molecules sublimation on these particles. (Author's abstract)
W89-12713

CHAOS IN RAINFALL.
Instituto Internacional de Estudios Avanzados, Caracas (Venezuela).
I. Rodriguez-Iturbe, B. Febres de Power, M. B. Sharifi, and K. P. Georgakakos.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1667-1675, July 1989. 7 fig, 3 tab, 13 ref. NSF grant CES-8657526.

Descriptors: *Rainfall distribution, *Rainstorms, *Storms, *Meteorology, *Chaos, *Hydrometeorology, Time series analysis, Mathematical studies, Precipitation.

The question is posed regarding possible chaotic dynamics in the temporal rainfall of storm events. Chaotic dynamics implies a nonlinear deterministic system very sensitive to initial conditions which yields outputs indistinguishable from a stochastic process by standard techniques. The trajectories of these systems in the phase space are characterized by being contained in a strange attractor of fractal dimension. A time series of 1990 points of 15-sec rainfall for the storm of October 25, 1980, in Boston was analyzed in detail. It is found that both the characteristics of the correlation integral and the Lyapunov exponents of the historical data give preliminary support to the presence of chaotic dynamics with a strange attractor. The implications of these findings for the modeling of storm rainfall and for the limits of predictability of the process are discussed. Different types of storms reflect different dynamic scenarios and a critical question is if this leads to structurally different strange attractors. The search for strange attractors in the space-time character of rainfall will help to clarify issues regarding the predictability of the phenomenon as well as some of the essential features which must be incorporated in the models. (Peters-PTT)
W89-12992

SULFATE PRODUCTION AND DEPOSITION IN MIDLATITUDE CONTINENTAL CUMULUS CLOUDS: PART I. CLOUD MODEL FORMULATION AND BASE RUN ANALYSIS.
Washington Univ., Seattle. Geophysics Program.
For primary bibliographic entry see Field 5B.
W89-13117

SULFATE PRODUCTION AND DEPOSITION IN MIDLATITUDE CONTINENTAL CUMULUS CLOUDS: PART II. CHEMISTRY MODEL FORMULATION AND SENSITIVITY ANALYSIS.
Washington Univ., Seattle. Geophysics Program.
For primary bibliographic entry see Field 5B.
W89-13118

MODELING CLIMATE CHANGE: AN ASSESSMENT OF SEA ICE AND SURFACE ALBEDO FEEDBACKS.
Meteorological Office, Bracknell (England). Dynamical Climatology Branch.
For primary bibliographic entry see Field 2A.
W89-13119

STRUCTURE AND DYNAMICS OF THE ARIZONA MONSOON BOUNDARY.
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
T. C. Adang, and R. L. Gall.
Monthly Weather Review MWREAB, Vol. 117, No. 7, p 1423-1438, July 1989. 15 fig, 3 tab, 24 ref. NASA Grant NAD8-36278.

Descriptors: *Monsoons, *Arizona, *Mexico, *Meteorology, *Climatology, Temperature, Moisture, Rainfall, Wind shear, Remote sensing, Radiosondes, Pacific Ocean Arizona Monsoon Boundary.

The Arizona Monsoon Boundary is defined as the boundary separating two distinctly different air masses over Mexico and the adjacent Pacific during the summer. The structure and dynamics of this boundary are examined by cross-sectional analysis using three different data sources: (1) a composite cross section through the boundary, constructed from the Fleet Numerical Oceanography Center (FNOC) analysis; (2) a time-height cross section, constructed using radiosonde observations at the time the boundary passed through Tucson in 1984; and (3) a cross section through the boundary on 22 July 1985, using high-resolution fields of temperature, moisture, and geopotential height obtained from the VISSR Atmospheric Sounder (VAS). All three cross sections showed similar structure. In some respects, the Arizona Monsoon Boundary resembles a mid-latitude front (i.e., there is a distinct and relatively sharp air mass change) forced almost entirely by confluence. A direct ageostrophic circulation is produced by this forcing, giving weak ascent on the warm, moist side of the boundary. The gradients and flow associated with the composite boundary are weaker, by a factor of four, than those associated with strong mid-latitude fronts. However, the VAS cross section suggests that, at times, the strength of the boundary approaches that of mid-latitude fronts. The wind shear suggested by the composite boundary ought to be unstable to baroclinic or barotropic processes and, hence, disturbances developing along the boundary are a distinct possibility. These disturbances have been observed and are reported elsewhere. (Author's abstract)
W89-13132

TROPICAL SQUALL LINES OF THE ARIZONA MONSOON.
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
W. P. Smith, and R. L. Gall.
Monthly Weather Review MWREAB, Vol. 117, No. 7, p 1553-1569, July 1989. 11 fig, 58 ref. NASA Grant NAS8-36278 and NASA Training Grant NGT-03-002-308.

Descriptors: *Monsoons, *Arizona, *Squalls, *Tropical storms, *Climatology, *Meteorology, Thunderstorms, Orographic precipitation, Rainfall, Satellite technology, Remote sensing, Arizona Monsoon, Clouds, Wind shear, Troposphere.

Squall lines possessing nearly all the characteristics of tropical squall lines occasionally develop during the summer monsoon over southern Arizona and northwestern Mexico. Initial thunderstorm formation is over the Continental Divide in the late afternoon and the systems become organized within a few hours. Satellite imagery, cloud-to-ground lightning strike data, and surface observations indicate the squall lines' move from east to west or northeast to southeast by discrete propagation faster than the environmental flow at all levels below 20 kPa so that most of the anvil clouds lag behind. The synoptic-scale circulation is anomalous, with a strong ridge located over the western United States and a deep trough located over the eastern United States. West to northwest winds are found in the boundary layer over southern Arizona and northwest Mexico, while a deep layer of east winds is observed above. As a result, most of the environmental wind shear is confined to the lowest 2.5 km above the ground, with very little shear at higher altitudes. The low-level wind shear seems to be required for the westward propagation of thunderstorms and the formation of the squall lines. Extremely dry midtropospheric air develops in an easterly flow through some combination of advection and subsidence and appears to be an important factor in the development of the squall lines and in the creation of severe thunderstorms. (Author's abstract)
W89-13133

RAINFALL VARIABILITY AT LONDON AND PLYMOUTH 1921-87.
Plymouth Polytechnic (England). Dept. of Marine Science and Technology.
N. L. H. Wood.
Weather WTHRAL, Vol. 44, No. 5, p 202-208, May 1989. 10 fig, 5 tab, 3 ref.

Descriptors: *Meteorology, *England, *Rainfall, *Variability, Time series analysis, Seasonal distribution, Long-term studies, London, Plymouth, Marine climates, Statistical methods, Comparison studies.

Variability of precipitation was examined for the period 1921-1987 at London and Plymouth (England). Seasonal cycle, trends, and variability are considered. Plymouth and London are 300 km apart; mean rainfall for the period 1921-1987 was 966 mm at Plymouth and 601 mm at London. Plymouth has a greater exposure to depressions from the Atlantic. Seasonal rain variability shows no trend over the 67-yr period. There are 5-yr and 10-yr periods throughout the smoothed record that show increases or decreases in 5-yr variability. The decrease since 1975 in rainfall variability at London and Plymouth and the increase in summer variability at Plymouth are examples. Ranking of seasons according to wetness, which is performed without reference to means, gives a strong indication of wetter winters in Plymouth since 1960 and drier summers in London since 1972. The different result obtained with ranking highlights how different statistical methods can yield different results from the same data. (Rochester-PTT)
W89-13134

STUDY OF RAINFALL SIMULATORS, RUNOFF AND EROSION PROCESSES, AND NUTRIENTS YIELDS ON SELECTED SITES IN ARIZONA AND NEW MEXICO.
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
T. J. Ward, and S. S. Bolin.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-205173/AS. Price codes: A05 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 241, April 1989. 67p, 23 tab, 17 ref, append.

Descriptors: *Computer models, *Infiltration, *Simulated rainfall, *Soil erosion, Nutrients, *Simulated rainfall, *New Mexico, Data collections, Hydrologic models, Hydrology, Parametric hydrology, Runoff plot, Sediment yield, Model studies, Arizona, Watershed management, Water chemistry.

Estimation of runoff and sediment yield from small, ungaged watersheds is a difficult hydrologic task. Process oriented mathematical models can be an important part in the solution task. Models, however, require some information which is directly related to the hydrologic processes occurring on the watershed. Rainfall simulation is an important experimental technique for gathering such information. This technical report contains the results of a study on the utility of using rainfall simulation in southwestern watersheds. Two different simulators were compared at three sites. At one site, three simulators were used, and one of the simulators was used to gather data at three additional sites. A small area simulator, 1 sq m, and two large area simulators, approximately 32.5 sq m, were operated for a total of about 74 plot experiments. One of the simulators was operated as part of USDA--ARS Water Erosion Prediction Project. Analysis of the data indicates that the simulators provide similar results for infiltration characteristics, and that sediment yields were about 4.0 times higher for the small simulator. Numerous water chemistry samples were analyzed to determine potential nutrient loadings from forest and range lands to water bodies in New Mexico. (Ward-NM St. U.)
W89-13321

2C. Snow, Ice, and Frost

SIMULATION OF SOIL FROST DEPTH AND EFFECT ON RUNOFF.
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 2E.
W89-12195

SUBGLACIAL AND GLACIAL COEXISTENCE OF ALGOFLORA (PODLEDNYE I LEDOVYE SOOBSHCHESTVA VODOROSLEI).
Bashkirskii Gosudarstvennyi Univ., Ufa (USSR).
For primary bibliographic entry see Field 2H.
W89-12272

PERENNIALLY ICE-COVERED LAKE HOARE, ANTARCTICA: PHYSICAL ENVIRONMENT, BIOLOGY AND SEDIMENTATION.
Nevada Univ., Reno. Desert Research Inst.
For primary bibliographic entry see Field 2H.
W89-12570

SUMMER SNOWFALLS OVER THE MOUNT OLYMPUS AREA.
Thessaloniki Univ., Salonika (Greece). Dept. of Meteorology and Climatology.
H. S. Sahsamanoglou.
International Journal of Climatology IJCLEU, Vol. 9, No. 3, p 309-319, May/June 1989. 5 fig, 7 tab, 10 ref.

Descriptors: *Greece, *Mountains, *Orographic precipitation, *Meteorology, *Snow, *Precipitation, *Air circulation, Weather data collections, Weather, Freezing.

Summer snowfalls over the Mount Olympus range (altitude $>$ 2500 m) in northern Greece were studied. This occurs about three times every and summer and is linked to the atmospheric circulation over Europe. At least two days before snowfall, a deep trough, reaching almost to the northern end of the western Mediterranean, causes a strong southward invasion of cold air. This cold air-mass movement results in cyclogenesis near northern Italy. A depression is formed that moves to the east, causing bad weather over northern Greece and a snowfall over the higher part of Mount Olympus. The freezing of air masses over the mountain area is so strong that the dry-bulb freezing level found at 640 hPa two days before snowfall reaches 710 hPa immediately after snowfall. (Author's abstract)
W89-12610

ESTIMATION OF SNOWDRIFT FILLING OF SECTIONS OF EARTH CANALS.
For primary bibliographic entry see Field 8B.
W89-12907

DISTRIBUTION OF LITTORAL MACROPHYTES IN A NORTH SWEDISH RIVERSIDE LAGOON IN RELATION TO BOTTOM FREEZING.
Umea Univ. (Sweden). Dept. of Ecological Botany.
For primary bibliographic entry see Field 2H.
W89-12931

EFFECT OF UNEVEN SNOW COVER ON AIRBORNE SNOW WATER EQUIVALENT ESTIMATES OBTAINED BY MEASURING TERRESTRIAL GAMMA RADIATION.
Arizona State Univ., Tempe. Dept. of Decision and Information Systems.
For primary bibliographic entry see Field 7B.
W89-12977

MODELING CLIMATE CHANGE: AN ASSESSMENT OF SEA ICE AND SURFACE ALBEDO FEEDBACKS.
Meteorological Office, Bracknell (England). Dynamical Climatology Branch.
For primary bibliographic entry see Field 2A.
W89-13119

PROTECTION OF GROUND-WATER MONITORING WELLS AGAINST FROST HEAVE.
Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD. Waste Disposal Engineering Div.
For primary bibliographic entry see Field 7B.
W89-13197

WINTER WATER QUALITY IN LAKES AND STREAMS.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 6G.
W89-13245

UNDER-ICE HYDRODYNAMICS AT TIOGA LAKE, PA.
Corps of Engineers, Baltimore, MD. Water Control Management Section.
For primary bibliographic entry see Field 2H.
W89-13246

2D. Evaporation and Transpiration

WINTER WHEAT RESPONSE TO WATER AND NITROGEN IN THE NORTH AMERICAN GREAT PLAINS.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2I.
W89-12333

INFLUENCE OF WATER AND NITROGEN LEVELS ON CANOPY TEMPERATURES OF WINTER WHEAT GROWN IN THE NORTH AMERICAN GREAT PLAINS.
Nebraska Univ.-Lincoln. Center for Agricultural Meteorology and Climatology.
For primary bibliographic entry see Field 2I.
W89-12337

YIELD AND WATER USE OF WINTER WHEAT IN RELATION TO LATITUDE, NITROGEN AND WATER.
Agricultural Research Service, Lubbock, TX. Cropping Systems Research Service.
For primary bibliographic entry see Field 2I.
W89-12338

SEASONAL CHANGE IN WATER USE AND CARBON ASSIMILATION OF IRRIGATED WHEAT.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
For primary bibliographic entry see Field 2I.
W89-12340

DAILY AND SEASONAL EVAPOTRANSPIRATION AND YIELD OF IRRIGATED ALFALFA IN SOUTHERN IDAHO.
Agricultural Research Service, Kimberly, ID.
J. L. Wright.
Agronomy Journal AGJOAT, Vol. 80, No. 4, p 662-669, July-August 1988. 5 fig, 3 tab, 18 ref.

Descriptors: *Evapotranspiration, *Crop yield, *Alfalfa, *Idaho, *Irrigation practices, *Irrigation effects, Agricultural hydrology, Soil-water-plant relationships, Silt, Loam, Plant growth, Arid zone, Diurnal variation, Seasonal variation, Water use, Water allocation, Resource allocation.

Daily water-use data are needed for the development of modern irrigation scheduling techniques, the optimum allocation of water and energy resources, an improved irrigation management practices. This field study was conducted to measure evapotranspiration (ET) of well-irrigated alfalfa (Medicago sativa L.) in the arid region of southern Idaho. The relationship of ET to forage yield was also investigated. The soil was Portneuf silt loam (coarse-silty, mixed, mesic Durixerollic Calciorthids) common to much of the region. Daily and seasonal ET data were calculated for seven growing seasons from measurements obtained with mechanical weighing lysimeters equipped with electronic load cells. Daily alfalfa ET was highly variable. It occasionally exceeded 10 mm/d and averaged 8 mm/d during peak ET periods. From April to October, measured eT averaged 1022 mm for three harvests per season for 5 yr when soil water was nonlimiting. Corresponding average forage yield was 17.6 Mg/ha (120 g/kg water content) giving an overall water requirement of 58.1 mm (depth equivalent) to produce 1 Mg/ha of forage (581 cu m/Mg) for a water-use efficiency of 17.2 kg/ha-mm. Harvest period and seasonal ET appear linearly related to pan evaporation and forage yield. The actual ET of well-irrigated, high-yielding alfalfa may be as much as 50% greater than previous estimates indicated for southern Idaho. (Author's abstract)
W89-12349

SIMULATION MODEL FOR STUDYING PHYSIOLOGICAL WATER STRESS RESPONSES OF WHOLE PLANTS.
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 2I.
W89-12439

COMPARISON OF TWO METHODS FOR DETERMINING THE EVAPOTRANSPIRATION AND DRAINAGE COMPONENTS OF THE SOIL WATER BALANCE.
Alberta Univ., Edmonton. Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W89-13180

2E. Streamflow and Runoff

GENERATION OF STREAM RUNOFF IN TILL SOILS.
Uppsala Univ. (Sweden). Dept. of Hydrology.
A. Roche.
Nordic Hydrology NOHYBB, Vol. 20, No. 1, p 1-8, 1989. 3 fig, 15 ref.

Descriptors: *Rainfall-runoff relationships, *Infiltration, *Streams, *Runoff, *Isotope studies, *Groundwater, *Tracers, *Till soils, Oxygen isotopes, Sweden, Hydraulic conductivity, Water table, Pressure head, Capillary conductivity, Groundwater movement, Rainfall, Snowmelt, Groundwater basins.

Some aspects of the runoff process are discussed from the results obtained by isotopic hydrograph separation in several Swedish basins using oxygen-18 as a tracer. Isotope studies in humid temperate areas show that runoff events in such areas are normally dominated by pre-event water. For the rapid and a large response of the groundwater outflow to rain-or meltwater input, observed indirectly in the isotope studies, two conditions must be fulfilled in the discharge area: (1) a sufficiently large gradient in total head must build up rapidly enough, and (2) the hydraulic conductivity and the cross section flow must be large enough. A few observations in Swedish till soils show a large increase in the hydraulic conductivity towards the ground surface. With such an increase, the groundwater outflow may increase manyfold, even by a moderate rise of shallow water table. In homogeneous soils, rapid and large head increments close to the stream, due to the effect of the capillary fringe, may be important. This effect may also generate rapid increments of deep groundwater outflow to the streams. Estimates based in expected particle velocities for the water flow in till soils show that the bulk of the groundwater particles discharged during a runoff event were situated within or close to the discharge area at the onset of the event. The area contributing to stream storm flow is defined as the area in which rainfall or snowmelt in some way contributes to the stream response during an event. The area contributing to fresh rain-or meltwater flow is mainly the saturated discharge area. The area contributing to groundwater flow is considerably larger, with the contribution decreasing in effectiveness from the vicinity of the discharge area towards more distant parts of the basin. (Miller-PTT)
W89-12194

SIMULATION OF SOIL FROST DEPTH AND EFFECT ON RUNOFF.
National Board of Waters, Helsinki (Finland). Water Research Inst.
B. Vehvilainen, and Y. Motovilov.
Nordic Hydrology NOHYBB, Vol. 20, No. 1, p 9-24, 1989. 5 fig, 10 ref.

Descriptors: *Frozen ground, *Rainfall-runoff relationships, *Runoff, *Frost, *Model studies, Air temperature, Snow depth, Simulation, Weather data collections, Calibrations, Model testing, Forest watersheds, Precipitation, Small watersheds.

A physically based soil frost depth model usable with air temperature data and precipitation data, is presented. Snow depth is calculated from precipitation data using a physical snow cover model. The soil frost depth model is tested in one small basin, with a five-year calibration and verification period. Results from snow depth and soil frost depth simulation were satisfactory also in the verification period. Although some simulation errors occurred in the modeling of the calibration and verification period, the overall simulation capability of the frost depth model was satisfactory during the ten-year period. The frost depth model is quite simple, needing only daily precipitation data and air temperature data (snow depth and density are simulated), and so can be run with operational watershed models if desired. In the second stage, simulated frost depth information was used to develop an HBV-runoff model version, attempting to simulate the possible effect of soil frost runoff. The simulation results are presented. These results suggest that soil frost does not have a very important effect on runoff in this forested basin. Soil frost depth has a minimal effect. This is obvious from examination of runoff curves; few differences would be corrected by assuming that soil frost increases runoff at the beginning of spring runoff and the situation is similar also for the other years in the calibration period. As compared to the unmodified model, the modified model did not improve model performance during the verification period. (Miller-PTT)
W89-12195

EPIDEMIOLOGICAL SIGNIFICANCE OF MICROBIOLOGICAL POLLUTION CRITERIA FOR RIVER RECREATIONAL WATERS.
Centre Alpin de Recherche Epidemiologique et de Prevention Sanitaire, Grenoble (France).
For primary bibliographic entry see Field 5B.
W89-12199

NEW FORM OF WATER QUALITY INDEX FOR RIVERS AND STREAMS.

Department of Scientific and Industrial Research, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 7C.
W89-12220

EPIPHYTIC ALGAE GROUPINGS IN CANALS, AND THEIR IMPACT ON WATER QUALITY (EPIFITNYE GRUPPIROVKI VODOROSLEI V KANALAKH I IKH ZNACHENIE DLIA FORMIROVANIIA KACHESTVA VODY).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 2H.
W89-12274

EFFECT OF A DEVELOPING ALGAL ASSEMBLAGE ON THE HYDRODYNAMICS NEAR SUBSTRATES OF DIFFERENT SIZES.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
M. A. Reiter.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 2, p 221-244, April 1989. 22 fig, 3 tab, 15 ref.

Descriptors: *Algal mats, *Streamflow, *Flumes, *Hydrodynamics, *Flow characteristics, *Flow friction, Velocity, Substrates, Reynolds number, Hydraulic roughness.

Vegetation has been shown to affect various hydrodynamic parameters of the surrounding water, including friction velocity, Reynolds number, and flow roughness. Recent studies indicate that benthic stream algae may also be able to influence the hydrodynamics of the local environment. To test this, algal assemblages were allowed to colonize flumes containing different substrates (smooth, 1-cm relief, and 2.5 cm relief). The velocity profiles were measured and converted to friction velocity, roughness height, and mixing length using theoretical equations. Mat height and dry weight biomass were also measured. Over time, mat development was accompanied by increases in friction velocity, roughness height, and mixing length in almost all cases. These increases appeared to be related to mat development. The height of the algal mat appeared to be limited by a maximum velocity or shear upon the upper algal cells, and was equal among flumes with a roughness height larger than the size of the roughness elements. The results suggest that increases in hydrodynamic parameters do occur with mat development, and may be assemblage-specific. In turn, the height of the mat may be controlled by the changing hydrodynamics. These results, though not necessarily contradictory to past research, should be tested under field conditions. (Author's abstract)
W89-12289

DIEL DRIFT AND VERTICAL STRATIFICATION OF DRIFTING MACROINVERTEBRATES IN A LARGE EUROPEAN RESERVOIR (RYTHME NYCTHEMERAL ET DISTRIBUTION VERTICALE DE LA DERIVE DES MACROINVERTEBRES BENTHIQUES DANS UNE GRANDE RIVIERE EUROPEENNE).
Lyon-1 Univ., Villeurbanne (France). Lab. d'Ecologie des Eaux Douces.
For primary bibliographic entry see Field 2H.
W89-12292

INFLUENCES OF A COLLECTOR-FILTERER CADDISFLY (TRICHOPTERA: HYDROPSYCHE BETTENI ROSS) ON LEAF PROCESSING RATES IN AN ARTIFICIAL STREAM.
Nebraska Univ.-Lincoln. Dept. of Biometrics and Information Systems.
For primary bibliographic entry see Field 2H.
W89-12304

UPPER MISSISSIPPI RIVER: SEASONAL AND FLOODPLAIN FOREST INFLUENCES ON ORGANIC MATTER TRANSPORT.
Illinois Natural History Survey, Havana. River Research Lab.
For primary bibliographic entry see Field 2H.
W89-12307

COLONIZATION OF NATURAL SUBSTRATA OF DIFFERENT ROUGHNESS AND COLOUR BY EPHEMEROPTERA NYMPHS USING RETRIEVAL AND DIRECT OBSERVATION TECHNIQUES.
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-12318

FORMATION OF PHENOL-PROTEIN COMPLEXES AND THEIR USE BY TWO STREAM INVERTEBRATES.
Mount Allison Univ., Sackville (New Brunswick). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-12322

FRESHWATER FLOW FROM THE EVERGLADES TO FLORIDA BAY: A HISTORICAL RECONSTRUCTION BASED ON FLUORESCENT BANDING IN THE CORA SOLENASTREA BOURNONI.
Australian Inst. of Marine Sciences, Townsville.
T. J. Smith, J. H. Hudson, M. B. Robblee, G. V. N. Powell, and P. J. Isdale.
Bulletin of Marine Science BMRSAW, Vol. 44, No. 1, p 274-282, January 1989. 6 fig, 1 tab, 28 ref.

Descriptors: *Tracers, *Paleohydrology, *Streamflow, *Florida Bay, *Fluorescence, *Everglades, *History, Surface waters, Drainage canals, Humic acids, Estuaries, Shark River Slough, Taylor Slough.

Fluorescent banding was found in a core taken from a 1-m high colony of the coral Solenastrea bournoni, which was growing in the Petersen Key Basin region of Florida Bay. Fluorescent banding in massive, hermatypic corals from the Great Barrier Reef, Australia, is known to result from the input of fulvic and humic compounds of terrestrial origin into the nearshore environment via river runoff. Relationships between the fluorescent banding pattern in the Solenastrea skeleton and flow in Shark River Slough (SRS) and Taylor Slough (TS), the two major outlets of freshwater from the Everglades, were investigated. These relationships were then used to hindcast flow for the period 1881-1939. In hindcasting flow in SRS, 57.2% of the variance in annual flow could be recovered from the fluorescent record, based on the period 1961-1986. When the model was tested on a validation sample (known SRS flow for 1940-1960) approximately 45% of the interannual variation was explained. The fluorescence record shows a sustained, marked, decline that began about 1912 and ended around 1931. Fluorescence is significantly higher ($p < 0.001$) early in the record (pre-1932) than late in the record (1932 and later). Based on the significant relationship between fluorescence and SRS flow, this decrease is interpreted as recording decreased freshwater flow from the Everglades into Florida Bay and adjacent waters, perhaps by as much as 59%. The onset of decreased flow corresponds with the timing of construction of the extensive network of drainage canals to the east and south of Lake Okeechobee. These canals diverted water into the Atlantic Ocean, which would normally have flowed into the Everglades from Lake Okechobee. (Author's abstract)
W89-12357

NEW PLOTTING-POSITION FORMULA FOR PEARSON TYPE-III DISTRIBUTION.
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
V. T. V. Nguyen, N. In-na, and B. Bobee.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 6, p 709-730, June 1989. 6 fig, 8 tab, 31 ref.

Descriptors: *Pearson distribution, *Streamflow, *Hydrologic data, *Probability distribution, *Estimating equations, *Statistical methods, Monte Carlo method, Mathematical analysis.

A new unbiased plotting-position formula was developed for the Pearson type-III (P3) distribution. The probability-weighted moment (PWM) method is used to estimate the exact plotting positions. The estimation of plotting positions for the P3 distribution using the PWM technique has several advantages over both the direct numerical integration method and the Monte Carlo simulation procedure. For the convenience of a practical application, a simple formula representing a very good approximation of the exact plotting positions is proposed. The suggested formula gave a better agreement with the exact plotting positions than several existing formulas. Further, the proposed formula is more flexible, because it can take explicitly into account the skewness coefficient of the underlying distribution. It is concluded that the developed plotting formula is the most appropriate for the P3 distribution and for both small and large samples. Finally, the development of probability papers for the P3 distribution for various skewness values is presented. Results of a numerical example have demonstrated the advantages related to the use of these special probability papers in engineering practice. (Author's abstract)
W89-12411

TURBULENCE CHARACTERISTICS OF SEDIMENT-LADEN FLOW.
Tsinghua Univ., Beijing (China). Sediment Research Lab.
W. Xingkui, and Q. Ning.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 6, p 781-800, June 1989. 14 fig, 4 tab, 15 ref, 2 append.

Descriptors: *Sediment transport, *Flow velocity, *Open-channel flow, *Turbulent flow, *Suspended sediments, Eddies, Probability distribution, Correlation coefficient, Density, Distribution, Mixing, Mathematical equations.

The turbulence structure of open-channel flow was measured and analyzed systematically in this study. The turbulence characteristics measured in clear water flow are essentially consistent with existing data. The turbulent intensity decreases with increase in concentration. In sediment-laden flow, the probability density distribution and the autocorrelation coefficient are similar to those of the clear water flow. Turbulent frequency decreases and turbulent energy is concentrated to large-size eddies with low frequency. The longitudinal sizes of macroscale and microscale eddies increase. These results show that for a Newtonian flow with noncohesive particles, the fundamental turbulent structure has no essential change--only the turbulent intensity and frequency have some changes in magnitude. Therefore, the mixing length theory can also be used to study the law governing the distribution of time-average velocity for a sediment-laden flow. (Dori-PTT)
W89-12415

BED WAVES GENERATED BY INTERNAL WAVES IN ALLUVIAL CHANNELS.
Technische Univ. Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
For primary bibliographic entry see Field 2F.
W89-12416

MOBILE-BED FRICTION AT HIGH SHEAR STRESS.
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-12418

FILAMENTOUS GREEN ALGAE IN FRESHWATER STREAMS ON SIGNY ISLAND, ANTARCTICA.
British Antarctic Survey, Cambridge (England).
For primary bibliographic entry see Field 2H.
W89-12549

EFFECTS OF NUTRIENT LIMITATION AND STREAM DISCHARGE ON THE EPILITHIC MICROBIAL COMMUNITY IN AN OLIGOTROPHIC ARCTIC STREAM.
Cincinnati Univ., OH. Dept. of Biological Sci-

ences.
For primary bibliographic entry see Field 2H.
W89-12550

MICROBIAL COMMUNITIES IN SOUTHERN VICTORIA LAND STREAMS (ANTARCTICA): I. PHOTOSYNTHESIS.
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
For primary bibliographic entry see Field 2H.
W89-12551

MICROBIAL COMMUNITIES IN SOUTHERN VICTORIA LAND STREAMS (ANTARCTICA): II. THE EFFECTS OF LOW TEMPERATURE.
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 2H.
W89-12552

NITROGEN DYNAMICS IN TWO ANTARCTIC STREAMS.
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 2H.
W89-12553

BENTHIC ALGAL BIOMASS AND PRODUCTIVITY IN HIGH SUBARCTIC STREAMS, ALASKA.
Alaska Cooperative Fishery Research Unit, Fairbanks.
For primary bibliographic entry see Field 2H.
W89-12554

BROADSCALE PATTERNS IN THE DISTRIBUTION OF AQUATIC AND TERRESTRIAL VEGETATION AT THREE ICE-FREE REGIONS ON ROSS ISLAND, ANTARCTICA.
Canterbury Univ., Christchurch (New Zealand). Dept. of Plant and Microbial Sciences.
For primary bibliographic entry see Field 2H.
W89-12555

COMMUNITY STRUCTURE OF BENTHIC INVERTEBRATES IN INTERIOR ALASKAN (USA) STREAMS AND RIVERS.
Alaska Univ., Fairbanks. Inst. of Arctic Biology.
For primary bibliographic entry see Field 2H.
W89-12556

VARIABILITY OF MACROINVERTEBRATE COMMUNITY COMPOSITION IN AN ARCTIC AND SUBARCTIC STREAM.
Cincinnati Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W89-12557

EFFECTS OF FLOODS ON EPILITHON AND BENTHIC MACROINVERTEBRATE POPULATIONS IN AN UNSTABLE NEW ZEALAND RIVER.
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-12594

EFFECTS OF AN EXPERIMENTAL ACID PULSE ON INVERTEBRATES IN A HIGH ALTITUDE SIERRA NEVADA STREAM.
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W89-12595

OCCURRENCE AND SIGNIFICANCE OF CLADOCERA (CRUSTACEA) IN SOME STREAMS OF CENTRAL INDIANA, U.S.A.
Indiana Univ. at Bloomington. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-12599

ESTUARINE TRANSPORT OF TRACE METALS IN A BUOYANT RIVERINE PLUME.
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 5B.
W89-12602

PREDICTING REAERATION RATES IN TEXAS STREAMS.
Texas Water Commission, Austin. Standards and Evaluation Section.
K. D. Cleveland.
Journal of Environmental Engineering (ASCE) JOEEDR, Vol. 115, No. 3, p 620-632, June 1989. 6 fig, 4 tab, 13 ref.

Descriptors: *Radioactive tracers, *Streamflow, *Mathematical studies, *Aeration, *Instream aeration, *Streams, *Texas, Regression analysis, Flow rates, Model testing, Aeration, Mathematical equations.

Krypton-85 was used to measure reaeration coefficients in numerous streams and rivers in Texas with various hydraulic characteristics. Flow rates ranged from 0.027 to 16.0 cm, velocities from 0.009 to 0.87 m/s, and depths from 0.17 to 1.83 m. Using a linear multiple regression technique, the Texas Reaeration Equation was developed for estimating reaeration coefficients in Texas streams and rivers. Statistical and graphical tools were used to evaluate this equation for accuracy and reliability and to determine the limits of its application. The methods of analysis of variance and analysis of residuals were used to evaluate this equation for accuracy and reliability and to determine the limits of its application. The methods of analysis of variance and analysis of residuals were used to evaluate the accuracy of the Texas Reaeration Equation. The 95% confidence intervals of the regression coefficients were also determined. The Texas Reaeration Equation adequately predicted reaeration coefficients in Texas streams and can be reliably applied to streams with depths from 0.2 to 1.0 m and velocities from 0.01 to 0.30 m/s. (Author's abstract)
W89-12620

STANDARD HEMISPHERES AS INDICATORS OF FLOW CHARACTERISTICS IN LOTIC BENTHOS RESEARCH.
Karlsruhe Univ. (Germany, F.R.). Zoologisches Inst.
B. Statzner, and R. Muller.
Freshwater Biology FWBLAB, Vol. 21, No. 3, p 445-459, June 1989. 9 fig, 3 tab, 19 ref.

Descriptors: *Flow characteristics, *Lotic environment, *Benthos, *Streamflow, *Flow measurement, *Flowmeters, Hemispheres, Hydraulic aspects, Lotic systems, Discharge variation.

Turbulence and forces of flow close to the bottom of streams are of major interest in benthos research. Flow close to the bottom of a stream is extremely complex. However, at a given flow, a hemisphere placed with its even side on a horizontal plane at the stream bottom integrates across much of the complexity because regardless of its orientation on the plane, it experiences the three-dimensionality of flow in the same way. To determine flow characteristics, standard hemispheres of identical size and surface but different densities were exposed on a horizontal plane at the bottom of streams. The heaviest hemisphere moved was used as an indicator of flow conditions close to the substrate. This method was an easily applicable and integrated indicator of key hydraulic characteristics (turbulence or force of flow prevailing at the stream bottom) previously measured in lotic benthos research, and can replace more laborious techniques. The hemispheres enabled a rapid flow characterization in stream reaches, in smaller areas where the benthos was being quantitatively sampled, and in en/exclosure cages used in experimental studies. This method also has the potential to characterize and compare physics of flow in individual running water segments with regard to frequencies and intensities of disturbances caused by long-term variations in discharge. The hemispheres could be used as a standard in benthic research, since they offer a well defined scale that is directly comparable not only between studies in running waters but also in wave-exposed shores of lakes and oceans. (Author's abstract)
W89-12682

INFLUENCE OF COPPER EXPOSURE ON PREDATOR-PREY INTERACTIONS IN AQUATIC INSECT COMMUNITIES.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 5C.
W89-12684

RELATIONSHIPS BETWEEN LEVELS OF RADIOCAESIUM IN COMPONENTS OF TERRESTRIAL AND AQUATIC FOOD WEBS OF A CONTAMINATED STREAMBED AND FLOODPLAIN COMMUNITY.
Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 5B.
W89-12688

ANNUAL PRODUCTION OF CREEK CHUB AND SOUTHERN REDBELLY DACE IN A SMALL WOODLAND STREAM.
Illinois Natural History Survey, Sullivan. Sullivan Lab.
For primary bibliographic entry see Field 2H.
W89-12707

CONSIDERATIONS ON THE ACCLIMATIZATION OF CASPIAN SEA INVERTEBRATES IN THE DNIEPER AND ITS RESERVOIRS (ITOGI AKKLIMATIZATSII BESPOZVONOCHNYKH KASPIISKOI FAUNY V DNIEPER I EGO VODOKLRANILISCHAKH).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 2H.
W89-12715

AMBIANCE OF THE FRESH WATER SPONGE IN DNIEPER-DONBASS CHANNEL (KONSORTSIIA PRESNOVODNOI GUBKI V KANALE DNEPR-DONBASS).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 2H.
W89-12719

EPISODIC FISH KILLS IN AN ACIDIFIED SALMON RIVER IN SOUTHWESTERN NORWAY.
Direktoratet for Vilt og Ferskvannsfisk, Trondheim (Norway). Fish Research Div.
For primary bibliographic entry see Field 5C.
W89-12747

PERIPHYTON, BENTHIC INVERTEBRATES AND FISHES AS BIOLOGICAL INDICATORS OF WATER QUALITY IN THE EAST BRANCH BRANDYWINE CREEK.
Pennsylvania Dept. of Environmental Resources, Norristown.
For primary bibliographic entry see Field 5A.
W89-12752

EFFECTS OF CU, CD AND ZN ON PHOTOSYNTHESIS OF FRESHWATER BENTHIC ALGAE.
National Inst. for Environmental Studies, Tsukuba (Japan).
For primary bibliographic entry see Field 5C.
W89-12754

CONSEQUENCES OF THE DEGRADATION OF ARVE RIVER ON ITS BANKS AND ON

BRIDGES AND OTHER WORKS: COMPREHENSIVE STUDY OF THE SEDIMENT TRANSPORT ALONG ITS COURSE (CONSEQUENCES DE L'ENFONGEMENT DU LIT DE L'ARVE SUR LES BERGES ET LES OUVRAGES: BILAN GENERAL DES TRANSPORTS SOLIDES SUR LE COURS D'EAU).
For primary bibliographic entry see Field 2J.
W89-12886

SEDIMENT TRANSPORT MODELLING OF ALLUVIAL RIVERS: AN ACTION OF A NATIONAL NATURE (LA MODELISATION DU TRANSPORT SOLIDE EN RIVIERE: UNE ACTION CARACTERE NATIONAL).
For primary bibliographic entry see Field 2J.
W89-12890

MODELING OF BED LOAD SEDIMENT TRANSPORT FOR FLUVIAL FLOW (MODELISATION DU CHARRIAGE EN ECOULEMENT FLUVIAL).
For primary bibliographic entry see Field 2J.
W89-12892

UPPER RHONE FLUSHES--REMARKS ON THE ACTIVITIES OF 1987 (LES CHASSES FRANCO-SUISSES SUR LE HAUNT-REFLEXIONS SUR LES OPERATIONS DE 1987).
Compagnie Nationale du Rhone, Lyon (France).
For primary bibliographic entry see Field 2J.
W89-12897

SUSPENDED LOAD OF THE CONGO AND UBANGUI RIVERS.
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France).
For primary bibliographic entry see Field 2J.
W89-12898

PREDICTION OF INVERTEBRATE COMMUNITIES USING STREAM MEASUREMENTS.
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 2H.
W89-12914

OBSERVATIONS ON FEEDING RELATIONSHIPS BETWEEN FISH PREDATORS AND FISH ASSEMBLAGES IN A MEDITERRANEAN STREAM.
Barcelona Univ. (Spain). Dept. of Animal Biology.
For primary bibliographic entry see Field 2H.
W89-12915

FISH POPULATION DYNAMICS IN THE RIVER FROME, DORSET.
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
For primary bibliographic entry see Field 2H.
W89-12916

RIVER WILDLIFE DATABASES AND THEIR VALUE FOR SENSITIVE ENVIRONMENTAL MANAGEMENT.
Anglian Water Authority, Lincoln (England). Lincoln Div.
For primary bibliographic entry see Field 2H.
W89-12917

WATERWAYS BIRD SURVEY OF THE BRITISH TRUST FOR ORNITHOLOGY: AN OVERVIEW.
British Trust for Ornithology, Tring (England). Waterways Bird Survey.
For primary bibliographic entry see Field 2H.
W89-12918

ASSESSMENT OF THE VALUE OF RIVERS FOR OTTERS.
Vincent Wildlife Trust, London (England).
For primary bibliographic entry see Field 2H.
W89-12919

DISTRIBUTION OF LITTORAL MACROPHYTES IN A NORTH SWEDISH RIVERSIDE LAGOON IN RELATION TO BOTTOM FREEZING.
Umea Univ. (Sweden). Dept. of Ecological Botany.
For primary bibliographic entry see Field 2H.
W89-12931

DISTRIBUTION OF SUBMERGED AQUATIC MACROPHYTE BIOMASS IN A EUTROPHIC STREAM, BADFISH CREEK. THE EFFECT OF ENVIRONMENT.
Wisconsin Univ., Madison. Dept. of Botany.
For primary bibliographic entry see Field 6G.
W89-12946

CONCENTRATIONS OF CD, SR, AND U IN FISH AND WATER SAMPLES COLLECTED FROM A SMALL STREAM RECEIVING URANIUM MINE DRAINAGE.
Turnbull Lab. for Ecological Studies, Cheney, WA.
For primary bibliographic entry see Field 5B.
W89-12950

SEASONAL REPRODUCTIVE DEVELOPMENT OF LAMPSILIS CARDIUM, AMBLEMA PLICATA PLICATA, AND POTAMILUS ALATUS (PELECYPODA: UNIONIDAE) IN THE UPPER MISSISSIPPI RIVER.
National Fisheries Research Center, La Crosse, WI.
For primary bibliographic entry see Field 2H.
W89-12955

FACTORS INFLUENCING THE ABUNDANCE OF BROOK TROUT (SALVELINUS FONTINALIS) IN FORESTED MOUNTAIN STREAMS.
Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie.
For primary bibliographic entry see Field 2H.
W89-12957

PHYTOPLANKTON DISTRIBUTION IN A TEMPERATURE FLOODPLAIN LAKE AND RIVER SYSTEM. I. HYDROLOGY, NUTRIENT SOURCES AND PHYTOPLANKTON BIOMASS.
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W89-12962

PHYTOPLANKTON DISTRIBUTION IN A FLOODPLAIN LAKE AND RIVER SYSTEM. II. SEASONAL CHANGES IN THE PHYTOPLANKTON COMMUNITIES AND THEIR CONTROL BY HYDROLOGY AND NUTRIENT AVAILABILITY.
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W89-12963

PHYCOLOGICAL AND PHYSICOCHEMICAL EVALUATION OF THE RIVER AYAD, UDAIPUR.
Sardar Patel Univ., Kaira (India). Dept. of Biosciences.
For primary bibliographic entry see Field 5B.
W89-12971

FREQUENCY DISTRIBUTION FOR SUSPENDED SEDIMENT LOADS.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2J.
W89-12983

COLONIZATION OF EXPERIMENTALLY DISTURBED PATCHES BY STREAM MACROINVERTEBRATES IN THE ACHERON RIVER, VICTORIA.
Monash Univ., Clayton (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-13004

ECOLOGICAL ANALYSIS OF DISTURBED RIVERBANKS IN THE MONTREAL AREA OF QUEBEC.
Montreal Univ. (Quebec). Inst. Botanique.
For primary bibliographic entry see Field 2H.
W89-13015

HEURISTIC ALGORITHMS FOR WASTE LOAD ALLOCATION IN A RIVER BASIN.
Indian Inst. of Tech., Bombay. Centre for Environmental Science and Engineering.
For primary bibliographic entry see Field 5G.
W89-13081

HYDRODYNAMIC ANALYSIS OF FLOODS IN URBAN SYSTEM.
Universidade Federal do Rio Grande do Sul, Porto Alegre (Brazil).
C. E. M. Tucci, B. P. F. Braga, and M. F. Amaral.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 4, p 523-540, July 1989. 10 fig, 2 tab, 12 ref.

Descriptors: *Flood forecasting, *Urban areas, *Brazil, *Hydrologic models, *Urban hydrology, *Rainfall-runoff relationships, Sao Paulo, Model studies, Management planning, Flood peak, Dams, Flood frequency, Tiete River.

Urban peak flows in metropolitan areas increase with urbanization. Demands for water supply, hydropower, and navigation also are increased. This creates a complex water system problem that requires rational water use. A hydrologic-hydrodynamic model was developed to simulate a river network system with hydraulic structures in an urban watershed. The hydrologic module was assembled with algorithms for the most important components of the hydrologic cycle in the basin using six parameters (rainfall, evaporation, basin physical characteristics, interception losses, soil storage losses, and surface and subsurface routing). The hydrodynamic module solves the Saint Venant equations through an implicit forward finite difference scheme. The model developed was applied to simulate floods in the metropolitan region of Sao Paulo, Brazil, which is the largest industrial complex in Latin America with 12,000,000 inhabitants. The model was applied to the upper Tiete River Basin in metropolitan Sao Paulo. Calibration of the flood event of 1981 and testing with another flood of larger magnitude showed that the model was adequate to simulate flood flows in this system. Two important issues raised by public administration, hydraulic structure operation rules and the effects of urbanization of flood flows, were successfully simulated by the model. Large transients due to gate operation at Edgard de Souza dam were represented adequately by the model. The model quantified the effects of different operation rules at Edgard de Souza dam, showing that flooding occurs only if the gates remain closed during a flood event. If the gates are opened at the beginning of rainfall, the influence of the dam is negligible. The effect of urbanization is expected to be important in downstream reaches, increasing the flood frequency severely. (Rochester-PTT)
W89-13131

WATER RESOURCES RESEARCH NEEDS IN THE ARABIAN GULF AREA.
Kuwait Inst. for Scientific Research, Safat. Environmental and Earth Sciences Div.
For primary bibliographic entry see Field 2A.
W89-13137

ADSORPTION OF THREE AMINO ACIDS TO BIOFILMS ON GLASS-BEADS.
Mount Allison Univ., Sackville (New Brunswick). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-13176

DENSITIES OF BENTHIC MACROINVERTEBRATES IN UPLAND WELSH STREAMS OF DIFFERENT ACIDITY AND LAND USE.
University Coll., Cardiff (Wales).
For primary bibliographic entry see Field 2H.
W89-13178

SIMPLE USE OF THE HAYAMI MODEL IN HYDROLOGY (UNE UTILISATION SIMPLE DU MODEL HAYAMI EN HYDROLOGIE).
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France). Section Hydrologie.
M. Baptista, and C. Michel.
Houille Blanche HOBLAB, Vol. 1989, No. 2, p 123-130, 1989. 5 fig, 3 tab, 5 ref. English summary.

Descriptors: *Flood routing, *Mathematical analysis, *Model studies, *Rivers, Routing.

An attempt was made to provide a simple tool to evaluate the problem of flood routing along a river reach. The aim was to provide a simple tool able to give a quick and comprehensive answer. The method is based on a diffusion model with constant coefficients, known as the Hayami model. The result is obtained by reading an abacus to identify the two parameters, flow velocity (C) and diffusion (D), specific to the reach under study. When the flooding area is not too variable, this method should be useful for a preliminary study. (Peters-PTT)
W89-13190

OUTLINE OF RIVER ADJUSTMENTS IN SMALL RIVER BASINS IN BELGIUM AND THE NETHERLANDS SINCE THE UPPER PLENIGLACIAL.
Rijks Geologische Dienst, Haarlem (Netherlands).
P. Clveringa, W. De Gans, W. Huybrechts, and C. Verbruggen.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 123-132, 5 fig, 51 ref.

Descriptors: *Geomorphology, *River basins, *River flow, *Flow discharge, *Belgium, *The Netherlands, *Paleohydrology, History, Water level fluctuations, Precipitation, Evapotranspiration.

Small river basins in lowland areas of Belgium and The Netherlands show four episodic river adjustments since the Upper Plenniglacial, dated at the end of the Pleniglacial/early Late Glacial and in the Late Dryas, Boreal, and Subboreal/Subatlantic. Based on the evolution of vegetation and temperature and the observation on episodic river adjustment two main causes for increased water discharge are discerned for the last 15,000 years: increased precipitation and decreased evapotranspiration. The differences between the river basins under the study can be explained in several ways: (1) not all of the river basins reacted with the same intensity, for the same length of time and to the same degree to changing (climatic and/or vegetational) conditions; (2) the number detected is dependent on the methods used and on the scientific objective of the investigations; and (3) the stratigraphic sequences of drainage basins are incomplete because of local dominance of erosional discontinuities. And sedimentation in the lower parts of the basins may be associated with erosional features occurring at the same time in the upper parts. (See also W89-13295) (Lantz-PTT)
W89-13307

EVOLUTION OF THE MORAVA RIVER IN LAKE PLEISTOCENE AND HOLOCENE TIME.
Ustredni Ustav Geologicky, Prague (Czechoslovakia).
P. Havlicek.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 133-136, 2 fig, 11 ref.

Descriptors: *Geologic history, *Rivers, *Geomorphology, *Morava River, *Paleohydrology, History, Alluvial plains, Loam, Sedimentation, Fluvial sediments, Flooding, Archaeology, Soil genesis, Stratigraphy, Dunes.

Detailed stratigraphical and geological studies of late Pleistocene and Holocene deposits in the Morava River drainage basin were part of the geological and paleobotanical investigation carried out in the Carpathian Foredeep and at the southeastern margin of the Bohemian Massif. The fluvial sandy gravel began to be laid down or redeposited in the Morava River alluvial plain at its confluence with the Dyje River during the last glaciation advance near Lanzhot village. In the middle and especially late Holocene, river beds began to change their course and deposited flood loam beds at various places and times. Floods resulting in the deposition of loam attained their peak toward the end of the middle Burgall, i.e. in a period from about 750 to 1,000 y BP, and also in the Middle Ages. Periods of flooding alternated with those of sedimentation tranquility to produce various soils on the surface. Flood plain sediments dating from the 8th century A.D. were found by archaeologists to lie at a depth of 2 to 4 m. A cultural layer of the Empire overlying a conspicuous subfossil soil suggests that the soil ceased to form at the turn of the 9th and 10th century A.D. Subsequent to it is a gap in sedimentation traceable till 1257 A.D. Studies of the alluvial plains in the Morava River basin have shown that the youngest flow loam (High Middle Ages to Recent) perfectly smoothened their originally highly rugged surface and hence concealed most of their communities and cemeteries dating from the Great Moravian Empire or still earlier periods. Areas unaffected by flood loam deposition are only covered with blown sand dunes. (See also W89-13295) (Lantz-PTT)
W89-13308

NEW METHODS OF RESEARCH ON THE HOLOCENE PALEOHYDROGRAPHY OF HUNGARY.
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 2H.
W89-13309

HOLOCENE VALLEY DEVELOPMENT ON THE UPPER RHINE AND MAIN.
Duesseldorf Univ. (Germany, F.R.). Abt. Geologie.
W. Schirmer.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 153-160, 3 fig, 15 ref.

Descriptors: *Geologic history, *Valleys, *Channel morphology, *Sedimentation, *Fluvial sediments, *Paleohydrology, *Geomorphology, Main River, Rhine River, Climatology, Europe, Sediment erosion, Sediment grading, Deposition.

On the Main River a detailed sequence of Late Glacial and Holocene reworking phases of the river has been worked out. The question was, whether this sequence of reworking phases would be local--caused by climatic events and human impact on the valley--or would indicate an influence of widespread climatic control has been concluded from previous investigations. Nevertheless further and more detailed evidence is necessary to provide solid proof that climate has caused different rivers to rework the valley sediments simultaneously and repeatedly. Results from the studies conducted on the Upper Rhine together with those on other Central European rivers, prove that the reworking phases of the River Main cannot be of local nature. There is a major controlling factor--the Holocene climate with its fluctuations--effecting the rhythmics of reworking phases in the river valleys. Consequently, the reworking phases of the River Main cannot be restricted to Middle Europe. They should occur elsewhere, modified locally by climatic features of an individual region, and, in the younger Holocene Period, modified by man's activity of that region. (See also W89-13295) (Lantz-PTT)
W89-13311

TECTONIC, ANTHROPOGENIC AND CLIMATIC FACTORS IN THE HISTORY OF THE VISTULA RIVER VALLEY DOWNSTREAM OF CRACOW.
Polish Academy of Sciences, Krakow. Inst. of Geography and Spatial Organization.
L. Starkel.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 161-170, 7 fig, 28 ref.

Descriptors: *Geologic history, *Valleys, *Geomorphology, *Vistula River, *Paleohydrology, *Tectonics, Climatology, Poland, Alluvial plains, Glaciation, Loess, Channels, Sedimentation, History, Aggradin Rivers, Meander, Loam, Subsidence, Glaciation.

Hydrologic history was studied downstream of the Cracow Gate in the western corner of the Sandomierz Basin, Poland. The catchment area exceeds 8500 sq km. The Vistula River's gentle meandering has a gradient of 0.3-0.4%, and in this reach is supplied mainly by small left-side tributaries from loess plateaus and not by the right-side Carpathian rivers. Below the loess-covered pleniglacial terrace extends the 5-8 km wide Holocene alluvial plan 4-6 m high and narrow channel-side benches of 2-3 m high actual flood plain. On this Holocene plain, few generations of the paleochannels can be distinguished, starting from straight streamways covered by Late Glacial deposits and Late Glacial paleomeanders below the edge of loess terrace filled by organic deposits or buried by sub-Atlantic aggradation. The next generation was formed during the Atlantic phase, partly buried by Neolithic slope was and, in the eastern part, well preserved due to late-Atlantic avulsion of the main channel. A specific feature of this reach is the aggradation of the Late Roman--medieval age. The remains of the oak forest cut by man in the 1st through 2nd century AD, is now covered by 5-6 m of sandy bars and loamy overbank deposits. The system of youngest paleomeander, formed during the last millenium, show a tendency to increase the meander radius from 200 to 600 m. From the early 19th century, downcutting of the river channel began, decreasing downstream. In comparison, other parts of the Subcarpathian basin's reach is characterized by a lack of dissection of Late Glacial erosional levels, and increased aggradation during the last two millenia. This fact can be related to the gentle subsidence in this part of the Sandomierz Basin. (See also W89-13295) (Author's abstract)
W89-13312

PLEISTOCENE-HOLOCENE BOUNDARY IN THE PO VALLEY SOUTH OF TORINO (NW ITALY).
Consiglio Nazionale delle Ricerche, Turin (Italy). Ist. di Ricerca per la Protezione Idrogeologica nel Bacino Padano.
D. Tropeano.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 171-181, 7 fig, 19 ref.

Descriptors: *Geologic history, *Geologic formations, *Valleys, *Paleohydrology, *Po River, Italy, Alluvial plains, Stratigraphy, Sedimentary structures, Swamps, History, Glaciation.

The sequence of Quaternary deposits in the subsoil of the Po River alluvial plain to some 30 km south of Torino has been studied by borehole data and gravel pit observations. In this area, deposits belonging to the following chronostratigraphical sequence have been generally recognized: (1) Pleistocene (sensu lato), a complex of sediments up to several tens of meters thick, for which it is quite impossible, for the time being, to give a more detailed definition--in this complex the upper layers belong at least in places to early and middle ages of Wurm; (2) Wurm 3 stage mainly represented by 5 to 30 m thick backswamp deposits, alternating to lenses of gravel, dating back to about 24,000 to 30,000 radiocarbon years BP; (3) Holocene (middle to recent). There is no evidence up to the present of deposits dating back before the Atlantic period. The whole thickness of Holocene sediments seems not to exceed 10-12 m. The data collected up to now suggest that a stratigraphic gap may exist between the end of the Wurm and the base of the Holocene sediments and that the peat horizon, where present, may be considered as a reference level to define the overlying sediments as being of Holocene age. (See also W89-13295) (Lantz-PTT)
W89-13313

VALLEY FLOOR DEVELOPMENT AND PALEOHYDROLOGICAL CHANGES: THE LATE VISTULIAN AND HOLOCENE HISTORY OF THE WARTA RIVER (POLAND).
Adam Mickiewicz Univ., Poznan (Poland). Quaternary Research Inst.
S. Kozarski, P. Gonera, and B. Antczak.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 185-203, 6 fig, 1 tab, 81 ref.

Descriptors: *Valleys, *Geologic history, *Geomorphology, *River beds, *Paleohydrology, *Warta River, *Poland, History, Sedimentary structures, Climatology, Flow discharge, Glaciation, Catchment basins, Vegetation.

Results of a case study on the Warta River, Poland demonstrate climatically controlled valley floor evolution and paleohydrological changes. Three low terraces, ie. bifurcation, transitional and floodplain, reveal distinct paleochannel scars; braided, large paleomeanders and small paleomeanders respectively. Well dated sequences of paleochannel fills show differences in the age of channel pattern as well as vegetation changes in the drainage basin. The latter generated threshold conditions in the system responsible for varying runoff and discharge, changing channel pattern and paleomeander geometry reflect paleohydrological conditions. The paleohydrological reconstruction in the study area was based on: (1) detailed investigation of former bed load (transport zones) in the paleochannel; (2) measurements of bed load in the present-day channel related to velocity distribution; and (3) estimation of paleovelocities with the application of empirical formulae. Using this procedure, a general paleohydrological tendency was found showing a decrease of discharges after the Bolling Interstadial until the end of the Subboreal Period from 263.9 cu m/sec to 51.7 cu m/sec. It is explained by a growing density of vegetation in the drainage basin correlated with plant recolonization after the recession of the last ice sheet. (See also W89-13295) (Author's abstract)
W89-13314

PROBLEM OF THE HYDROLOGICAL INTERPRETATION OF PALAEOCHANNEL PATTERN.
Adam Mickiewicz Univ., Poznan (Poland). Inst. of Physical Geography.
J. Rotnicka, and K. Rotnicki.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 205-224, 12 fig, 1 tab, 75 ref.

Descriptors: *Geologic history, *Hydrological regime, *Channel morphology, *Alluvial channels, *Paleohydrology, Flow discharge, Braided streams, Meanders, Vegetation, Flow velocity.

The channel pattern is often used in paleohydrology as an indicator of the hydrologic regime. The term 'hydrologic regime', however, is variously understood, which results in the ambiguity of using channel pattern as an indicator of past hydrological conditions. This article presents the results of testing the hypothesis that a river channel pattern is a result of discharge variability; a meandering channel--by this hypothesis--is the effect of a small variability of discharges, while a braided channel results from their great variability. Research on discharge variability for 28 reaches of Polish and Yugoslav rivers with specific channel patterns leads to a rejection of this hypothesis for rivers of the temperate climate. Thus, the channel pattern cannot be used in paleohydrologic studies as the criterion for determining a past hydrologic regime understood as discharge variability. Useful in paleohydrological terms are investigations which allow the determination, for a given type of alluvia and a given type of vegetation along the channel banks, of those threshold velocities at which the channel pattern changes from braided to meandering and vice versa. (See also W89-13295) (Lantz-PTT)
W89-13315

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN MARYLAND, DELAWARE, AND THE DISTRICT OF COLUMBIA.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-13328

WATER QUALITY DATA (OCTOBER 1987 THROUGH SEPTEMBER 1988) AND STATISTICAL SUMMARIES (MARCH 1985 THROUGH SEPTEMBER 1988) FOR THE CLARK FORK AND SELECTED TRIBUTARIES FROM GALEN TO MISSOULA, MONTANA.
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-13347

WATER RESOURCES ACTIVITIES IN FLORIDA, 1988-89.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-13358

ALASKA INDEX: STREAMFLOW, LAKE LEVELS, AND WATER QUALITY RECORDS TO SEPTEMBER 30, 1988.
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-13378

LOW-FLOW PROFILES OF THE COOSA RIVER AND TRIBUTARIES IN GEORGIA.
Geological Survey, Doraville, GA. Water Resources Div.
R. F. Carter, E. H. Hopkins, and H. A. Perlman.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-0153, 1989. 217p, 1 fig, 13 ref. Project 4513-00101.

Descriptors: *Flow profiles, *Low flow, *Georgia, *Surface water availability, *Wastewater dilution, Discharge frequency, Drainage area, Coosa River.

Low-flow information is provided for use in evaluating the capacity of Georgia streams to permit withdrawals or to accept waste loads without exceeding the limits of State water quality standards. The information also will be useful in planning future flow-data collection programs, as well as expediting the work of planners, engineers, and others who use low-flow information. This report, which is the sixth in a series of reports presenting the results of a low-flow study of all stream basins north of the Fall Line in Georgia, covers the Coosa River. The low-flow characteristic presented is the minimum average flow from 7 consecutive days with a 10-year recurrence interval (7Q10). The data are presented in tables and shown graphically as 'low-flow profiles' (low flow plotted against distance along a stream channel) and as 'drainage-area profiles' (drainage area against distance along a stream channel). Low-flow profiles were constructed by interpolation or extrapolation from points of known low-flow data. Low-flow profiles are included for all stream reaches where low-flow data of sufficient accuracy are available to justify computation of the profiles. Drainage-area profiles are included for all stream basins larger than 5 sq mi, except for those in a few remote areas. Flow records were not adjusted for diversions or other factors that caused measured flows to represent conditions other than natural flow. The 7-day, minimum-flow profile was omitted for stream reaches where natural flow was known to be altered substantially. (Author's abstract)
W89-13385

HYDRAULIC DATA FOR SHALLOW OPEN-CHANNEL FLOW IN A HIGH-GRADIENT FLUME WITH LARGE BED MATERIAL.
Geological Survey, Reston, VA.
F. J. Watts.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4001, 1989. 108p, 11 fig, 3 tab.

Descriptors: *Open-channel flow, *Flumes, *Channel morphology, *Bed load, *Flumes, *Turbulent flow, *Roughness coefficient, Steady flow, Velocity coefficient, Velocity distribution, Average velocity, Flow rates.

Hydraulic data for shallow open-channel flow in a high-gradient flume with large bed material are reported. The bed surface consists of natural rock having particle-size range of 0.15 to 0.75 ft. Two different bed-surface configuration (roughness) were tested. The bed material was stable for all discharges. The flume wall was composed of smooth plastic and aluminum, and the test channel was 6 ft wide and 108 ft long. Longitudinal test slopes ranged from 0.008 to 0.018. Hydraulic data are reported for 103 runs with surface flows ranging from 0.7 to 32.1 cu ft/sec and for 11 runs with subsurface flows ranging from 0.1 to 0.7 cu ft/sec. Hydraulic data for all runs include water surface elevation and average bed elevation at 10 cross sections and test discharge. Detail velocity measurements at two or more cross sections are reported for selected runs. The bed-material data include shape and size properties of the rock, detailed topographic measurements of the bed surface for each of the two roughnesses that were tested, and 14 statistical parameters computed from the topographic measurements. The statistical parameters include the mean elevation of the bed, the skew of the elevations, the kurtosis of the elevations, and the standard deviation from the arithmetic mean elevation for each station. (USGS)
W89-13387

WATER RESOURCES OF THE UPPER BIG WOOD RIVER BASINS, IDAHO.
Geological Survey, Boise, ID. Water Resources Div.
S. A. Frenzel.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4018, 1989. 47p, 13 fig, 9 tab, 35 ref.

Descriptors: *Water yield, *Water resources data, *Idaho, *Water quality, *Big Wood River basin, Available water, Water management, Surface-groundwater relations, Trail Creek, Warm Springs Creek, Big Wood River.

Mean annual water yields, estimated using a water-budget method, for the upper Big Wood River basin above Glendale Road and for Trail Creek, Warm Springs Creek, and East Fork Big Wood River, Idaho were 410,000, 50,000, 60,000 and 50,000 acre-ft, respectively. Yields also were estimated for 1986 and 1987 water years when data were collected for comparison with long-term average values. During 1986, yields estimated for upper Big Wood River basin, Trail Creek, Warm Springs Creek, and East Fork Big Wood were 580,000, 61,000, 83,000 and 60,000 acre-ft, respectively. During 1987, yields estimated for the respective basins were 230,000, 26,000, 32,000 and 28,000 acre-ft. Availability of surface and groundwater varies seasonally; the greatest quantity is available during spring snowmelt, and the least is available during mid-winter to late winter. Nutrient concentrations in sampled ground and surface water were near or below detection levels throughout the basin, which indicates that water quality has not been impaired by increased development. Fluoride concentrations were elevated in Warm Springs Creek, probably due to inflow of thermal water. (USGS)
W89-13389

NATIONAL WATER SUMMARY 1986--HYDROLOGICAL CONDITIONS AND GROUNDWATER QUALITY.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-13395

LONG-TERM RECONSTRUCTION AND ANALYSIS OF WHITE RIVER STREAMFLOW.
Arkansas Univ., Fayetteville. Dept. of Geography.
M. K. Cleavland, D. W. Stahle, and J. G. Hehr.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-214464/AS. Price codes: A03 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Publication No. 135, June 1988. 41p, 4 fig, 2 tab, 50 ref, 2 append. USGS Project G-1409-02.

Descriptors: *Climates, *Dendrochronology, *Stochastic hydrology, *White River, *Time series analysis, *Rainfall-runoff relationships, Rivers, Drought, Arkansas, Missouri, Planning, Paleohydrology.

A 281-year reconstruction of White River annual runoff at Claredon, Arkansas, was developed from a regional average of nine Oklahoma, Missouri, and Arkansas tree-ring chronologies (six post oak, Quercus stellata, and three bald cypress, Taxodium distichum. Inhomogeneity of the gaged series was detected with both double mass analysis (using state average total annual Arkansas precipitation) and regression (using the regional tree-ring average). Simple regression calibrated the homongeneous runoff data with the average ring width data from 1930-1980. Comparing the reconstruction with independent data verified the regression model. Variance of the reconstruction increases significantly during the 20th century, a change that may be caused by climatic shifts or by anthropogenic disturbances in the watershed. Years of surplus and deficit runoff are non-randomly distributed in both gaged and reconstructed series. This non-randomness appears to be caused by a significant tendency for inter-annual persistence of runoff extremes, which may provide a basis for improvement of probabilistic forecasts of White River runoff. (Cleavland-AR U. WRRI)
W89-13403

LATE QUATERNARY PALEOHYDROLOGY OF THE EASTERN MOJAVE RIVER DRAINAGE, SOUTHERN CALIFORNIA: QUANTITATIVE ASSESSMENT OF THE LATE QUATERNARY HYDROLOGIC CYCLE IN LARGE ARID WATERSHEDS.
New Mexico Univ., Albuquerque. Dept. of Geology.
For primary bibliographic entry see Field 2A.
W89-13404

EVALUATION OF METHODS FOR THE ESTIMATION OF TRIBUTARY MASS LOADING RATES.
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W89-13405

2F. Groundwater

EXPERIMENTAL STUDIES OF MASS TRANSPORT IN POROUS MEDIA WITH LOCAL HETEROGENEITIES.
Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.
For primary bibliographic entry see Field 5B.
W89-12190

GENERATION OF STREAM RUNOFF IN TILL SOILS.
Uppsala Univ. (Sweden). Dept. of Hydrology.
For primary bibliographic entry see Field 2E.
W89-12194

FINITE ELEMENT ANALYSIS OF CONTROLLED SALTWATER INTRUSION IN HETEROGENEOUS RESERVOIRS.
Tage Sorensen, Consulting Engineers Ltd.
A. Refsgaard, S. Christensen, and J. Reffstrup.
Nordic Hydrology NOHYBB, Vol. 20, No. 1, p 25-42, 1989. 11 fig, 1 tab, 16 ref.

Descriptors: *Coastal aquifers, *Groundwater pollution, *Cleanup operations, *Model studies, *Saline water intrusion, Coastal waters, *Reservoirs, Heterogeneous reservoirs, Finite element method, Heterogeneity, Flooding, Pumping, Saline-freshwater interfaces, Density, Permeability, Homogeneity, Digital computers, Model testing, Boundary conditions.

Results are presented for a computer simulation of saltwater movements during pumping in a heterogeneous coastal reservoir. To analyze the controlled flooding by intruding salt seawater of a coastal region polluted by chemical waste products, a two-dimensional finite element model has been developed. The model was especially developed for the simulation of non-steady state density dependent flow and mass transport in heterogenous porous media. The flooding of the polluted area by salt seawater was established by pumping. The use of the finite element model has shown that this numerical method is well suited for the solution of such complicated flow problems. Especially the ability of the method to allow for adjustments of the finite elements mesh has proved to be valuable. To give better representation of the tilted chloride concentration fronts the finite element mesh was tilted to coincide with the shape of the front in part of the solution domain, causing a reduction in computation time and an increase in accuracy. Also, the finite element method has proved to be very robust in handling large variations in density and permeability. The model was used to study the influence of heterogeneities on the efficiency of the flooding process. Controlled saltwater flooding in two model aquifers was studied, one with a homogeneous structure and one with a heterogeneous layered structure with large permeability contrasts, the latter reflecting the geological characteristics of the site. The analysis showed that large variations in permeability greatly influence the way the polluted area will be flooded and the efficiency of the flooding process. The model used was verified against test data from the literature giving almost identical results as compared to published results from similar models. Minor differences were observed due to differences in the implementation of boundary conditions and the order of the interpolation functions as well as number of elements used. (Miller-PTT)
W89-12196

EFFECT OF HETEROGENEITY ON LARGE SCALE SOLUTE TRANSPORT IN THE UNSATURATED ZONE.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics Engineering.
G. Destouni, and V. Cvetkovic.
Nordic Hydrology NOHYBB, Vol. 20, No. 1, p 43-52, 1989. 6 fig, 10 ref.

Descriptors: *Path of pollutants, *Groundwater movement, *Heterogeneity, *Solute transport, *Unsaturated flow, Stochastic models, Groundwater recharge, Hydraulic conductivity, Water table, Porosity, Saturation, Groundwater level, Numerical analysis, Field tests.

The effect of natural heterogeneity on large scale solute transport in the unsaturated zone is investigated using stochastic methods. Several of the physical parameters that control flow and solute transport in the unsaturated zone are regarded as random fields. Specifically, the influence of spatial variability in recharge applied on the surface, saturated hydraulic conductivity, water content at saturation and depth to the groundwater table, on solute flux into the groundwater is illustrated. The spatial variability in the recharge applied on the surface, R, and in the depth to the groundwater table, Z, appear to have the most significant effect on solute transport through the unsaturated zone. In comparison, the effect of the variability in the water content at saturation (porosity), theta sub s, is negligible, if theta sub s is assumed to be an independent random variable. If however, theta sub s is assumed perfectly correlated with the saturated hydraulic conductivity, K sub s, it influences the solute movement more notably by neutralizing the variability in K sub s, provided that the unsaturated flow is dominant. Although this analysis is based in a relatively simple flow model, it clearly indicates that natural spatial variability in the physical parameters may have the most significant effect, and should therefore be taken into account for obtaining accurate estimates of solute flux through the unsaturated zone. These results indicate which of the parameters have a more dominant effect; this may aid in formulating sampling procedures. However, assessing the applicability of the present model to specific field conditions requires further numerical and field experimentation. (Miller-PTT)
W89-12197

EFFECT OF WATER DEFICIT AT DIFFERENT GROWTH PHASES OF PEANUT: III. RESPONSE TO DROUGHT DURING PREFLOWERING PHASE.
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
For primary bibliographic entry see Field 2I.
W89-12346

TRANSPORT OF MICROSPHERES AND INDIGENOUS BACTERIA THROUGH A SANDY AQUIFER: RESULTS OF NATURAL-AND FORCED-GRADIENT TRACER EXPERIMENTS.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-12380

ISOTOPIC AND TRACE ELEMENT CONSTRAINTS ON THE ORIGIN AND EVOLUTION OF SALINE GROUNDWATERS FROM CENTRAL MISSOURI.
California Inst. of Tech., Pasadena. Div. of Geological and Planetary Sciences.
For primary bibliographic entry see Field 2K.
W89-12399

BED WAVES GENERATED BY INTERNAL WAVES IN ALLUVIAL CHANNELS.
Technische Univ. Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
B. de Jong.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 6, p 801-817, June 1989. 6 fig, 2 tab, 31 ref, append.

Descriptors: *Channel morphology, *Bed load, *Sediment transport, *Waves, *Internal waves,

*Alluvial channels, *Dunes, *Ripple marks, *Streambeds, Open-channel flow, Stratified flow, Density, Distribution, Velocity, Numerical analysis.

A theory was developed to explain the generation of dunes and ripples on an erodible bed in open-channel flow. The flow is conceived as a stratified flow both with respect to the velocity distribution and the density distribution of the sediment-fluid mixture. The free internal waves that may occur in such a flow are assumed to be the triggering mechanism for the generation of dunes and ripples on an initially flat bottom. The effectiveness of the theory is demonstrated by comparing the calculated free waves with the peaks in the bed-wave spectrum as measured at small times after starting the flow in a channel with an initially flat bed. The theory shows that dunes are generated by internal waves corresponding with the steady free-surface waves. Ripples are due to free internal waves that occur only in flows with sediment transport. The theory has been demonstrated for bed load transport. However, an extension to any other transport mode is straightforward. (Author's abstract)
W89-12416

SIMPLE GROUNDWATER LABORATORY MODELS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Div. of Engineering Fundamentals.
S. S. Crider, and B. L. Sill.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 6, p 818-822, June 1989. 1 fig, 2 tab, 9 ref, append.

Descriptors: *Model studies, *Groundwater movement, *Hydraulic models, *Solute transport, Hydraulic conductivity, Sandstones, Rocks, Wells, Costs, Cost analysis, Mortar.

A simple, inexpensive way to build hydraulic models is useful in the study of groundwater flow in consolidated rocks. The uniform, rectangular weak mortar model performed according to simple analytical models. Solute dispersion was similar to that found in field and laboratory tests using consolidated (and even some unconsolidated) materials; the model seemed to behave most like sandstone. Hydraulic conductivity remained constant during tests that usually lasted 5 days; the model was in use for 3 months. Wells were easily drilled anytime and anywhere they were needed. Cost of materials and labor (10 hr of work for one person) was less than $500. Consequently, weak mortar models provide the desired features of rigidity, simplicity, availability, and low cost. They overcome a problem earlier groundwater models have had with channeling resulting from consolidation and repacking of the medium. Hence, weak mortar could conceivably be used to build a three-dimensional scaled model of an actual site. Since the hydraulic properties of weak mortar can be determined more cheaply than natural materials, weak mortar models can be used to verify mathematical and numerical models. (Doria-PTT)
W89-12417

GROUNDWATER MOVEMENT AND STORAGE IN KARSTIC LIMESTONE AQUIFERS OF JAMAICA.
Hydrology Consultants Ltd., Kingston (Jamaica).
M. N. White.
Journal of the Geological Society of Jamaica, Vol. 23, p 1-16, 1985. 5 fig, 1 tab, 16 ref.

Descriptors: *Groundwater management, *Groundwater movement, *Groundwater storage, *Karst hydrology, *Water resources development, *Aquifer characteristics, *Jamaica, Limestone, Transmissivity, Specific yield, Aquifer testing, Conduits, Flow characteristics, Diffusivity, Flow nets, Dye releases, Permeability, Analog models, Hydrologic budget, Pollutants, Seasonal variation.

The nature and distribution of transmissivity and specific yield within karstic limestone aquifers of Jamaica are presented. It is suggested that groundwater movement through these aquifers is controlled by conduit flow, whereas specific yield is a function largely of primary and secondary porosity, i.e., diffused flow, and attempts were made to identify and quantify their respective roles in groundwater movement and storage in the Upper Rio Cobre Basin in east-central Jamaica. Rate of groundwater movement, discussed in terms of transmissivity, was explored through aquifer tests, flow net analysis, and groundwater tracers. The flow control mechanism and formation of conduit permeability is discussed. Groundwater storage was investigated through qualitative considerations and estimates of specific yield (laboratory measurement, aquifer tests, analog determination, and water balance determination). Problems are experienced in the development and management of karstic groundwater basins in Jamaica which are directly related to the karstic nature of its aquifers. The most significant problems are the siting of successful wells, seasonal variation in well yield, naturally occurring inorganic turbidity, protection/rehabilitation of groundwater quality, and determination of appropriate resource management strategies and techniques. Some solutions to these problems include siting wells within the reservoir areas of the aquifers, reducing the rate of production of wells during periods of high turbidity, using alternative disposal methods for contaminating waste and/or artificial recharge techniques, and undertaking more thorough hydrologic investigations. A basic understanding of the karstic limestone aquifers in Jamaica has been achieved. The next major step is likely to involve the testing and refining of this understanding by the use of more definitive investigative techniques. (Fish-PTT)
W89-12459

ANALYSIS BASED ON INTEGRATED CONSERVATION LAW FOR DISCONTINUOUS ROCK: COUPLED ANALYSIS OF STRESS, HEAT TRANSFER AND GROUNDWATER FLOW.
Saitama Univ., Urawa (Japan). Faculty of Technology.
For primary bibliographic entry see Field 5B.
W89-12475

SURVIVAL OF VIRUSES IN GROUNDWATER.
Webster (Arthur) Pty Ltd., Baulkham Hills (Australia).
For primary bibliographic entry see Field 5E.
W89-12482

GROUNDWATER.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W89-12537

NITRATE LEACHING UNDER IRRIGATION IN THE UNITED STATES.
Delaware Univ., Newark. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W89-12626

RISK ANALYSIS FOR DAM DESIGN IN KARST.
For primary bibliographic entry see Field 8A.
W89-12628

NONLINEAR STEADY STATE SEEPAGE INTO DRAINS.
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Water Resources and Environmental Engineering.
S. Mustafa, and N. A. Rafinadadi.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 358-376, June 1989. 8 fig, 24 ref, append.

Descriptors: *Seepage, *Percolation, *Water table, *Drain spacing, *Drains, Mathematical studies, Groundwater movement, Mathematical equations, Recharge, Model studies, Drainage systems, Drainage patterns.

Analytical solutions for water table profiles between drains and drain spacing formulas resulting from nonlinear seepage under steady rainfall recharge are presented. Nonlinear seepage conditions are introduced in the derivation of the equations, which are found be generalizations of those conventionally used on the basis of Darcy's linear law. The validity of the equations derived was established in a series of experiments on a sand tank seepage flow model in which nonlinear flow conditions were generated, giving rise to actual water-table profiles. The equations derived in herein were found to show close agreements with experimental results and with similar studies reported by some authors, and to provide for greater economy in the design of drainage systems. (Author's abstract)
W89-12632

USE OF A STOCHASTIC MODEL OF A FRACTURE NETWORK TO STUDY THE HYDRAULIC PROPERTIES OF A FISSURED ROCK MASS (UTILISATION D'UN MODELE STOCHASTIQUE DE RESEAUX DE FRACTURES POUR ETUDIER LES PROPRIETES HYDRAULIQUES D'UN MASSIF FISSURE).
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
L. Ait-ssi, J. P. Villeneuve, and A. Rouleau.
Canadian Geotechnical Journal CGJOAH, Vol. 26, No. 2, p 313-323, May 1989. 11 fig, 5 tab, 27 ref. English summary.

Descriptors: *Hydraulic properties, *Groundwater movement, *Fracture permeability, *Bedrock, *Stochastic models, Injection tests, Dams, Simulation analysis, Hydraulic conductivity.

This study of the hydraulic properties of a fractured rock mass is based on data from field injection tests and fracture measurements, and on simulation of the fracture system in the bedrock upstream from the Daniel Johnson dam at Manic 5. Analysis of water injection tests indicates that the bedrock can be divided into two zones with respect to the permeability. The more permeable zone, which is the object of this study, shows a log-normal distribution of the hydraulic conductivities. Using several stochastic simulations of fracture networks, the fracture aperture has been adjusted gradually to reproduce the rock mass permeability estimated from injection tests. The results show that the fracture system geometry, as well as the fracture porosity and the fracture lengths and densities, influences widely the hydraulic properties of a fractured medium and particularly the fracture porosity. Also, the estimation of the fracture porosity is sensitive to a number of other factors, including the assumed hydraulic boundary conditions, the field estimation of the hydraulic conductivities, and the orientation of the simulation planes. (Author's abstract)
W89-12672

FIELD STUDIES: HARDY ROAD LANDFILL AND INDUSTRIAL EXCESS LANDFILL, A SUPERFUND SITE.
Akron Univ., OH. Center for Environmental Studies.
For primary bibliographic entry see Field 5E.
W89-12706

HYDROGEOLOGY OF THE IORI-SHIRAKI ARTESIAN BASIN AND AN OUTLOOK FOR USING ITS UNDERGROUND WATER (GIDROGEOLOGIIA I PERSPEKTIVY ISPOL'ZOVANIIA POZEMNYKH VOD IORI-SHIRAKSKOGO ARTEZIANSKOGO BASSEINA).
S. N. Zedginidze, and N. V. Khukhia.
Soobshcheniia Akademii Nauk Gruzinskoi SSR SAKNAH, Vol 130, No 2, p 365-368, May 1988. 1 fig, 1 tab, 3 ref. English summary.

Descriptors: *Groundwater budget, *Artesian basins, *Groundwater management, Geohydrology, Potential water supply.

The prospects of using the underground water of the Iori-Shiraki artesian basin were investigated in a hydrogeological study. Recommendations were developed as to how to use the Iori-Shiraki under-

ground waters in the best way to provide a water supply for the population. (Author's abstract)
W89-12712

GROUNDWATER CONTAMINATION: PUMP-AND-TREAT REMEDIATION.
California Univ., Los Angeles. School of Public Health.
For primary bibliographic entry see Field 5G.
W89-12756

AGRICULTURE AND GROUNDWATER QUALITY.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 5B.
W89-12771

PLANNING GROUND WATER MONITORING FIELD PROJECTS.
SCS Engineers, Inc., Long Beach, CA.
For primary bibliographic entry see Field 7A.
W89-12873

APPLICATION OF TEMPERATURE AND ELECTRICAL-CONDUCTIVITY LOGGING IN GROUND WATER MONITORING.
Whitman Companies, Inc., East Brunswick, NJ.
For primary bibliographic entry see Field 7B.
W89-12874

SCREENING OF GROUND WATER SAMPLES FOR VOLATILE ORGANIC COMPOUNDS USING A PORTABLE GAS CHROMATOGRAPH.
Geological Survey, Iowa City, IA.
For primary bibliographic entry see Field 5A.
W89-12876

HYDROPUNCH: AN IN SITU SAMPLING TOOL FOR COLLECTING GROUND WATER FROM UNCONSOLIDATED SEDIMENTS.
Weston (Roy F.), Inc., Albuquerque, NM.
For primary bibliographic entry see Field 7B.
W89-12877

HYDRAULIC CONDUCTIVITY MEASUREMENTS IN THE UNSATURATED ZONE USING IMPROVED WELL ANALYSES.
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 7B.
W89-12878

CIRCULAR CONVECTION DURING SUBSURFACE INJECTION OF LIQUID WASTE, ST. PETERSBURG, FLORIDA.
Geological Survey, Tampa, FL.
For primary bibliographic entry see Field 5E.
W89-12975

SEMIANALYTIC BOUNDARY ELEMENT SOLUTION OF GROUNDWATER SEEPAGE PROBLEMS.
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
M. M. Aral.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1495-1503, July 1989. 11 fig, 14 ref.

Descriptors: *Groundwater movement, *Mathematical analysis, *Pumping, Confined aquifers, Numerical analysis.

A numerical solution was developed for the analysis of groundwater flow problems using semianalytic time integration procedures and the boundary element method. The secondary reduction method is an integral part of this computation process. Compared to finite difference procedures, which are commonly used for time integration in boundary element applications, the semianalytic computation yields more efficient and accurate results. The proposed method was test on a groundwater seepage problem in a confined aquifer. The numerical results obtained were verified using analytical procedures available in the literature and compared with other boundary element solutions. The comparison of the results with other numerical procedures demonstrated the accuracy and efficiency of the proposed technique in the solution of diffusion dominant, time dependent problems. (Peters-PTT)
W89-12976

ANALYSIS OF NATURAL GROUNDWATER LEVEL VARIATIONS FOR HYDROGEOLOGIC CONCEPTUALIZATION, HANFORD SITE, WASHINGTON.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5E.
W89-12979

MODIFIED METHOD OF CHARACTERISTICS TECHNIQUE AND MIXED FINITE ELEMENTS METHOD FOR SIMULATION OF GROUNDWATER SOLUTE TRANSPORT.
Shell Development Co., Houston, TX.
For primary bibliographic entry see Field 5B.
W89-12981

GROUNDWATER TRAVEL TIME UNCERTAINTY ANALYSIS USING SENSITIVITY DERIVATIVES.
INTERA Technologies, Inc., Austin, TX.
For primary bibliographic entry see Field 5B.
W89-12982

FIELD SCALE TRANSPORT OF BROMIDE IN AN UNSATURATED SOIL. 1. EXPERIMENTAL METHODOLOGY AND RESULTS.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W89-12984

FIELD SCALE TRANSPORT OF BROMIDE IN AN UNSATURATED SOIL. 2. DISPERSION MODELING.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W89-12985

NEW ANALYSIS PROCEDURE FOR DETERMINING AQUIFER PROPERTIES FROM SLUG TEST DATA.
Tulsa Univ., OK. Dept. of Petroleum Engineering.
A. M. M. Peres, M. Onur, and A. C. Reynolds.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1591-1602, July 1989. 9 fig, 2 tab, 41 ref.

Descriptors: *Pumping tests, *Slug tests, *Aquifer testing, *Aquifer characteristics, *Hydraulic properties, *Test wells, *Discharge measurement, Well data, Transmissivity, Mathematical analysis, Water level.

A new method for determining hydraulic properties from slug test well data in a confined aquifer is based on an exact equation which converts measured slug test head data to equivalent head data that would be obtained due to a constant discharge of a well with well bore storage and skin effects. A related procedure yields equivalent head derivative data (time rate of change of head) that would be obtained for the classical constant discharge with well bore storage and skin problem without applying numerical differentiation. After the constant discharge head data and its derivative data are generated, these converted data can be analyzed by using existing well bore storage and skin type curves for the appropriate aquifer/well model. Therefore slug test type curves are no longer needed. For cases in which the relative change in the water level is not significant during the slug test, most of the converted data will fall on the unit slope line of the conventional well bore storage and skin type curves and it will be difficult to obtain a unique type curve match of converted head data. For such cases, a discharge normalization procedure can be applied to improve the reliability of the analysis. A field case illustrates the reliability of the new method. (Author's abstract)
W89-12986

IMPELLER METER FOR MEASURING AQUIFER PERMEABILITY VARIATIONS: EVALUATION AND COMPARISON WITH OTHER TESTS.
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W89-12993

POTENTIAL THEORY-BASED FINITE ELEMENT ALGORITHM FOR FRESHWATER RECHARGE OF SALINE AQUIFERS: A SHARP INTERFACE MODEL.
Haryana Agricultural Univ., Hissar (India). Dept. of Soils.
S. P. Singh, and W. N. Stammers.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1685-1694, July 1989. 7 fig, 2 tab, 36 ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Saline water, *Aquifers, *Mathematical models, *Saline-freshwater interfaces, Recharge basins, Recharge, Finite element method, Model studies.

The size and shape of the freshwater lens developed during the freshwater recharge of thick, unconfined saline aquifers was investigated through a potential theory-based finite element method (implicit difference-in-time scheme) in which the air-freshwater free surface and the fresh-saltwater interface boundary conditions have been integrated in the Galerkin's finite element formulation of the flow equation through Green's theorem in an interactive scheme using a sharp interface assumption. The model can also be applied to locate the positions of the fresh-saltwater interface and the air-freshwater free surface for recharge of strip oceanic islands. The model results are verified through experimental studies conducted on a Hele-Shaw analogue. (Author's abstract)
W89-12994

BOUNDARY AND INTERFACE CONDITIONS IN POROUS MEDIA.
CyberLink Corp., Boulder, CO.
S. M. Hassanizadeh, and W. G. Gray.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1705-1715, July 1989. 2 fig, 18 ref. NATO Grant 0213/87.

Descriptors: *Groundwater movement, *Anisotropy, *Path of pollutants, *Saline-freshwater interfaces, *Mathematical analysis, Groundwater pollution, Porous media, Flow characteristics.

Correct specification of conditions at macroscopic surfaces of discontinuity and along the boundary is essential to the complete mathematical description of flow and transport in porous media. A framework was developed for the systematic derivation of appropriate conditions, which allows for generalization of the conditions commonly in use and exposes the assumptions which underlie them. General balance equations for a zone separating two regions were simplified to the case where the regions are in good thermodynamic contact. By application, interface conditions for balance of mass, chemical species, momentum, and energy were obtained for (1) adjacent porous media containing the same fluid, (2) water flooding of an oil reservoir, (3) a salt water/freshwater interface, and (4) the boundary between a surface water body and the porous medium. (Author's abstract)
W89-12996

MODEL FOR HYSTERETIC CONSTITUTIVE RELATIONS GOVERNING MULTIPHASE FLOW 3. REFINEMENTS AND NUMERICAL SIMULATIONS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 2G.

W89-12998

OPTIMAL PUMPING TEST DESIGN FOR THE PARAMETER IDENTIFICATION OF GROUNDWATER SYSTEMS.
California Univ., Los Angeles. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W89-12999

TWO-DIMENSIONAL TRANSPORT AND FATE OF CHEMICALS EMITTED BY ARBITRARILY PLACED SOURCES IN CONFINED AQUIFERS.
Oregon State Univ., Corvallis. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W89-13000

TRANSPORT OF DISSOLVED SUBSTANCES WITH SECOND-ORDER REACTION.
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 5B.
W89-13001

UPDATING RANDOM HYDRAULIC CONDUCTIVITY FIELDS: A TWO-STEP PROCEDURE.
Michigan Technological Univ., Houghton. Dept. of Geology and Geological Engineering.
J. W. Massmann, and R. A. Freeze.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1763-1765, July 1989. 10 ref. NSF grant CES-8858526.

Descriptors: *Groundwater movement, *Statistical analysis, *Kriging, *Hydraulic conductivity, Stochastic process, Mathematical studies, Traveltime.

The prediction of groundwater travel times at field sites is generally uncertain because of uncertainty and variability in hydrogeological parameters, especially the hydraulic conductivity. A two-step procedure has been developed for increasing the hydraulic conductivity variance after measurements have been collected. In this procedure, the measurements are first used to calculate posterior estimates of the moments of the spatial stochastic process. In the second step, the data are used in a conditional sense, taking into account measurement locations. The vector of prior mean values is replaced with the vector of unconditional posterior mean values, and the matrix of prior variances and covariances is replaced with the matrix of unconditional posterior variances and covariances. The updating step can be carried out using either the Bayesian approach or the traditional kriging approach. (Peters-PTT)
W89-13002

KARST CONTAGION MODEL: SYNOPSIS AND ENVIRONMENTAL IMPLICATIONS.
Austin Peay State Univ., Clarksville, TN. Dept. of Geology and Geography.
P. R. Kemmerly.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 2, p 137-143, March-April 1989. 2 fig, 14 ref.

Descriptors: *Path of pollutants, *Karst hydrology, *Geohydrology, *Geomorphology, *Groundwater movement, *Groundwater pollution, Conduits, Monitoring wells, Pennyroyal Plain, Kentucky, Western Highland Rim, Tennessee, Contagion model.

The contagion model of karst terrane evolution focuses on the environmental implications for a large karst depression population on the Pennyroyal Plain (southern Kentucky) and the adjacent Western Highland Rim (Tennessee) immediately south of the Mammoth Cave Plateau. In karst terranes where the contagion model applies, there is a well-defined infrastructure comprised of hydrologic, structural geologic and geomorphic interacting elements that result in clustered depressions underlain by a radial conduit system. Clusters tend to be randomly distributed and typically contain a parent depression surrounded by numerous daughters. Groundwater flow is assumed to be turbulent and confined largely to conduits that are 3-dimensionally configured between clusters in a dendritic to trellis network. Parent depressions serve as conduit nodes for collecting groundwater migrating from beneath daughter depressions. Flow velocities in the 3-dimensional 'cluster-cell' conduits exceed those in granular media by several orders of magnitude, making pathogen and chemical contaminant migration rapid. Groundwater quality assessment in karst conduit hydrogeologic settings is difficult because monitoring wells are inappropriate. Monitoring wells may have a low probability of intercepting a major conduit and therefore the sampling regime must take into consideration the pulse discharge of pollutants in karst conduits. Representative water quality data must come from springs located near the local base level. (Author's abstract)
W89-13010

ACCIDENTS DUE TO OXYGEN DEFICIENCY AND METHANE GAS BLOW-OFF IN TOKYO AREA, JAPAN.
Akita Univ. (Japan). Coll. of Mining.
H. Hayashi, and M. Ishii.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 2, p 167-177, March-April 1989. 6 fig, 2 tab, 12 ref.

Descriptors: *Accidents, *Underground structures, *Construction, *Oxygen deficiency, *Natural gas, *Methane gas blow-off, *Aquifers, *Groundwater level, *Interstitial water, *Tokyo, Water pressure, Alluvial deposits, Sediments, Fires, Explosions, Japan.

The groundwater level in the Tokyo area has declined to about 60 m below the surface because of excess withdrawal of groundwater from various aquifers. Many construction workers died due to oxygen deficiency at construction sites from 1960-80, the period of decreasing groundwater level. The compressed air in pneumatic foundation construction sites passed easily through the aquifer, and the oxygen in it was consumed by ferrous ions oxidizing to ferric ions. During periods of high barometric pressure, atmospheric air penetrates into the strata and it is deoxygenated there. Suffocation occurred not only at construction sites in underground excavations, but also in residences in Tokyo. Such accidents have become less frequent with recovery of the pore-water pressure in aquifers, which has accompanied the recovery of the groundwater level since 1972. With the recovery of the pore-water pressure and the groundwater level in the aquifer, fires and explosions resulting from gushes of methane have occurred in Tokyo lowlands since 1973. These blow-off gases are classified into two types: Kameido and Asakusa. Gas of the Kameido type originates from the Kazusa Group and migrates into upper alluvial deposits or Pleistocene sediments because of the recovery of pore-water pressure in the Kazusa Group. Gas of the Asakusa type formed from the air that penetrated the aquifers during the period of low groundwater level. Methane was produced by the depletion of oxygen accumulated in alluvial deposits and Pleistocene sediments. This gas blows off through wells in alluvial deposits and Pleistocene sediments at times of low barometric pressure. Accidents of the Asakusa type will not happen when the groundwater level and pore-water pressure in alluvial and Pleistocene sediments is restored to previous levels. (Author's abstract)
W89-13011

MAPPING PESTICIDE CONTAMINATION POTENTIAL.
Hawaii Univ. at Manoa, Honolulu. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W89-13017

APPLICATION OF ROBOTICS IN THE WATER INDUSTRY AND THE DEVELOPMENT OF A BOD ROBOT.
Southern Water Authority, Brighton (England).
J. Hawkins, and A. Lloyd.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 937-945, 1989. 3 fig, 2 tab, 1 ref.

Descriptors: *Water treatment, *Biochemical oxygen demand, *Water sampling, *Automation, *Laboratory equipment, Robotics, Sample preparation, Water analysis, Calibrations, Standards, Precision, Pumps, Cost analysis, Capital costs, Operating costs, Labor.

The application of robotics in water authority laboratories is reviewed and the development of a robotic biochemical oxygen demand (BOD) analyzer is described. The Reading Laboratory of Thames Water Authority uses the Peerless robot in a partially-automated version of the BOD test. The main problems encountered during sample preparation have been loss of positional accuracy in the robot when combining rotational and vertical movements and systematic errors in dilution caused by wear in the peristaltic pump tubes. The positional fault was eliminated by replacing combined movements with sequential, rather than simultaneous movements. The pump problem has been overcome by means of a program to calibrate the pump at the beginning of each batch of analysis. The results of early tests showed that whereas good agreement was obtained for synthetic standards, the robot gave significantly lower results for real samples. This was overcome by increasing the rate of air flow. At a capital cost of 40,000 pounds and with revenue costs of approximately 1000 pounds per year, the cost-effectiveness of the investment may be considered to be marginal. As experience and confidence in the system develops, it should be possible to insert escape or bypass routines into the software. It is concluded that the robotic technique is the more precise and that no significant bias exists between data produced by the two methods. Robotics appear to offer the best means of automating procedures which require a high manipulative input. It is therefore important that the water industry funds research into techniques that may ultimately improve the level of service and reduce operating costs. The BOD test is both monotonous and tedious to perform. It requires constant concentration and is extremely unpopular with laboratory staff. By releasing staff from the BOD test, it was anticipated that the Authority would ultimately benefit from implementation of new technology which is seen to improve working conditions. (Miller-PTT)
W89-13070

HYDROLOGIC EFFECTS OF INTENSE GROUNDWATER PUMPAGE IN EAST-CENTRAL HILLSBOROUGH COUNTY, FLORIDA, U.S.A.
Southwest Florida Water Management District, Brooksville.
For primary bibliographic entry see Field 6G.
W89-13114

WATER RESOURCES RESEARCH NEEDS IN THE ARABIAN GULF AREA.
Kuwait Inst. for Scientific Research, Safat. Environmental and Earth Sciences Div.
For primary bibliographic entry see Field 2A.
W89-13137

INVESTIGATIONS OF GROUNDWATER RESOURCES IN CENTRAL JORDAN.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
H. Bender, M. Hobler, H. Klinge, and K. Schelkes.
Desalination DSLNAH, Vol. 72, No. 1/2, p 161-170, Apr/May 1989. 5 fig, 2 tab, 9 ref.

Descriptors: *Oil shale, *Groundwater mining, *Water supply development, *Jordan, Groundwater potential, Fuel resources, Water demand, Aridzone hydrology, Numerical analysis, Hydrologic budget, Natural recharge, Seepage, Drainage, Geologic fractures, Wadi, Groundwater storage, Groundwater recharge, Drilling, Pumping, Oil recovery, Process water.

Oil shale deposits in Jordan may considerably contribute to the country's fuel consumption for the

next three decades. A basic problem is the high water demand of a processing plant which, in the case of arid Jordan, has to depend almost entirely on groundwater resources. Based on recent investigations, a two-dimensional numerical model covering an area of approximately 2000 square kilometers was developed. The water balance derived from steady state calibration of aquifers showed that the quantities of recoverable groundwater from the upper aquifer system have been widely overestimated in the past. Recharge to this aquifer is largely lost by seepage into the lower aquifer as well as by drainage into the Dead Sea through major fault lines and wadi channels. Present water abstraction for drinking water and industrial purposes already exceeds recharge. The future demand has to be extracted from the aquifer's storage (groundwater mining). Groundwater abstraction from the deep aquifer is technically feasible but economically constrained (deep drilling, excessively high pumping lifts). (Author's abstract)
W89-13147

APPLICATION OF BACTERIOPHAGE AS TRACERS OF CHALK AQUIFER SYSTEMS.
Surrey Univ., Guildford (England). Dept. of Microbiology.
H. Skilton, and D. Wheeler.
Journal of Applied Bacteriology JABAA4, Vol. 66, No. 6, p 549-557, June 1989. 8 fig, 2 tab, 14 ref.

Descriptors: *Aquifer systems, *Tracers, *Groundwater movement, *Bacteriophage, *Viruses, *Wastewater disposal, *Environmental tracers, *Path of pollutants, Land disposal, Aquifer characteristics, Vertical flow, Landfills, Aeration zone, Aquifer testing, Enteroviruses, Pumping tests, Boreholes, Hydrologic properties, Geohydrology, England, Chalk.

The disposal of wastewater and sewage sludge on land is widespread and has been practiced for thousands of years. It is disposed of in the United Kingdom three ways: (1) on agricultural land either by direct application of treated or untreated sludge to arable land and grassland or by subsurface injection; (2) other land outlets such as landfills, reclaimed land, and forestry; and (3) by the marine environment. There have been a few investigations into the vertical migration of viruses through soil and the unsaturated zone beneath land application sites, where in several cases human enteric viruses have migrated vertically through the unsaturated zone to reach the groundwater table. Three tracer experiments were performed at two chalk groundwater sites. In the first experiment three bacteriophage were injected into a chalk aquifer at three different depths, 16.5 meters from a pumping well. Two of the bacteriophage were recovered from the abstraction point, giving a fastest migration rate of 17-34.5 centimeters/hour. In the second experiment, three bacteriophage were injected at different depths at a different chalk site, one kilometer away from the pumping well. A small percentage of two of the bacteriophage were recovered at a fastest migration rate of 30-29.5 centimeters/hour. At the same site, two bacteriophage were injected into a different borehole 50 meters away from the pumping well. Neither were recovered. These bacteriophage tracer experiments expose several interesting hydrogeological features about each aquifer system, and reassert bacteriophage as excellent tracers at groundwater sites. (Author's abstract)
W89-13158

OCCURRENCE OF PERENNIAL SEAWARD SEEPAGES OF POTABLE WATER IN PARTS OF NIGER DELTA, NIGERIA.
Port Harcourt Univ. (Nigeria). Dept. of Geology.
P. A. Amadi.
Ground Water GRWAAP, Vol. 27, No. 4, p 467-472, July-August, 1989. 8 fig, 1 tab, 9 ref.

Descriptors: *Water resources development, *Geohydrology, *Groundwater movement, *Potable water, *Niger Delta, *Nigeria, Aquifers.

The water-supply scheme in many rural and periurban communities in the Niger Delta of Nigeria occurs as underground seaward seepages that are under cover of sea water about twice daily all the year round. Their shoreline environment notwithstanding, they remain soft and fresh throughout the year, and they are slightly acidic with pH ranges from 5.0 to 6.0. Partial chemical analysis show that the pattern of changes in the geochemistry of the seaward seepages between seasons differs markedly from that of the groundwater of the Niger Delta. The observed pattern suggests that these potable seepages do not originate from the groundwater regime of the Delta but from another portion of the hydrologic cycle that probably involves some seaward-bound underground streams which, due to changes in lithology or to the gradual land-to-sea break of slope or both, have been forced to surface at the coastal tip as seepages. (Author's abstract)
W89-13160

MODELING OF GROUND-WATER RECHARGE IN SOUTHERN BALI, INDONESIA.
Lavalin, Inc., Montreal (Quebec).
G. L. Nielsen, and J. M. Widjaya.
Ground Water GRWAAP, Vol. 27, No. 4, p 473-480, July-August, 1989. 6 fig, 6 tab, 10 ref.

Descriptors: *Recharge, *Model studies, *Infiltration, *Groundwater recharge, *Soil absorption capacity, *Aquifers, Bali, Indonesia, Calcareous soils.

The major aquifers in Southern Bali include a Pliocene lower calcareous sequence and a Quaternary upper volcanic sequences. Both exhibit rapid lateral and vertical facies changes, and hence hydrogeologic parameters are highly variable. Yields of up to 90 L/s are known from the calcareous system and up to 60 L/s from the volcanic formations. Groundwater recharge was estimated by five different techniques. Analysis of well hydrographs have 468 mm per annum for 1984-1985. Annual infiltration of 25% of rainfall gave an average recharge of 437 mm. Baseflow separation of five years of stream discharge data gave 272 mm/annum discharge, approximately equal to recharge, much of which, however, is removed for irrigation upstream of the gauge. A flownet analysis gave 492 mm/annum average discharge, approximately equal to annual recharge. A model for recharge was prepared, using all relevant available soil, land use, hydrogeological, and meteorological data for calibration. It calculated annual recharge in a year of above average rainfall to be 645 mm for light soils 538 mm for medium soils, and 376 mm for heavy clay soils. Annual recharge in an average rainfall year (1980, 1983) was 605 mm for light soils, 504 mm for medium soils, and 308 mm for heavy soils. In a drought year (1976), recharge was 481 mm in light soils, 401 mm in medium soils, and 267 mm in heavy soils. (Author's abstract)
W89-13161

ORIGIN OF THE SALINE GROUND WATER IN WADI AR-RUMAH, SAUDI ARABIA.
A. M. Sowayan, and R. Allayla.
Ground Water GRWAAP, Vol. 27, No. 4, p 481-490, July-August, 1989. 8 fig, 3 tab, 11 ref.

Descriptors: *Saline water intrusion, *Groundwater, *Aquifers, *Saline water, *Geohydrology, *Saudi Arabia Wadis, Pumping.

Among the geologic formations traversed by Wadi Ar-Rumah in north central Saudi Arabia, is the Saq Sandstone, an extensive and vitally important aquifer. However, the aquifer contains highly saline water in the area where area is agriculturally important, but the saline water has caused, and is likely to continue to cause problems due to its intrusion into other parts of the aquifer as a result of heavy pumping. The geology, hydrogeology, and hydrochemistry, of the area was examined in this study. Pertinent field data were used to explain the likely way in which the saline water was formed. At the end of the last pluvial period, the ephemeral runoff in the wadi decreased and a clay layer was deposited on its floor. Groundwater was near the surface and its evaporation by capillary draw led to a concentration of solutes. A shallow clay layer prevent wadi flows from flushing out the saline groundwater. (Author's abstract)
W89-13162

HORIZONTAL ANISOTROPY OF THE PRINCIPAL GROUND-WATER FLOW ZONE IN THE SALINAS ALLUVIAL FAN, PUERTO RICO.
Geological Survey, San Juan, PR.
V. Quinones-Aponte.
Ground Water GRWAAP, Vol. 27, No. 4, p 491-500, July-August, 1989. 7 fig, 3 tab, 10 ref.

Descriptors: *Anisotropic aquifers, *Geohydrology, *Model studies, *Groundwater movement, *Drawdown, *Alluvial fans, *Puerto Rico, *Hydrologic models, Transmissivity, Computer programs.

Well drawdown data from an anisotropic aquifer in the Salinas alluvial fan were collected and analyzed with a computer program called TENSOR2D. The program uses ordinary and weighted least-squares optimization procedures to solve the system of simulations equations needed to define the theoretical transmissivity ellipse. Results from the alluvial fan aquifer at Salinas, Puerto Rico indicated that when applying the ordinary least-squares method: (1) the major and minor transmissivity tensors are 52,339 and 17,800 sq ft/day respectively; (2) the square root of the major and minor diffusivity tensors are 12,066 and 7,036 sq ft/d; (3) the ratio of horizontal anisotropy is 2.94 to 1.00; and (4) the direction of major anisotropy tensor is along a line 31 degrees west from the true north. From the application of the weighted least-squares method: (1) the major and minor transmissivity tensors are 38,840 and 23,987 sq ft/d, (2) the square root of the major and minor diffusivity tensors are 11, 282 and 8,8966 sq ft/d, (3) the ratio of horizontal anisotropy is 1.62 to 1.00, and (4) the direction of major anisotropy tensor is along a line 28 degrees west of the true north. Prediction of drawdown data was made by coupling the anisotropy ellipse with the Hantush modified leaky-confined or Theis model. Drawdown data predicted by using the theoretical direction diffusivity obtained with the weighted least-squared fit gave a more accurate representation of the actual drawdown data then when using the test-data directional diffusivity. (Author's abstract)
W89-13163

AUTOMATED CALIBRATION OF A CONTAMINANT TRANSPORT MODEL FOR A SHALLOW SAND AQUIFER.
Interstate Commission on the Potomac River Basin, Rockville, MD.
For primary bibliographic entry see Field 5B.
W89-13164

THREE-DIMENSIONAL MIXING CELL SOLUTE TRANSPORT MODEL AND ITS APPLICATION.
New Mexico State Engineer Office, Santa Fe.
B. K. Rao, and D. L. Hathaway.
Ground Water GRWAAP, Vol. 27, No. 4, p 509-516, July-August, 1989. 8 fig, 13 ref.

Descriptors: *Path of pollutants, *Saline water intrusion, *Aquifers, *Hydrologic models, *Solute transport, *Groundwater movement, Chlorides, Model studies.

A three-dimensional mixing cell solute transport model has been developed based on the principles of conservation of mass for water and solute. As a first approximation to solute transport phenomenon, dispersion is ignored, but it is recognized that the numerical dispersion introduced as an artifact of the solution procedure represents physical dispersion in the results obtained from the model. The numerical dispersion can be controlled to some extent. The simplicity of principles on which the model is based makes it easy to understand and use. The formulation is used in conjunction with the McDonald and Harbaugh groundwater flow model. The model has been applied to an aquifer located in southern new Mexico and Texas to predict chloride concentration changes resulting from proposed future pumping to supply municipal water for the city of El Paso, Texas. (Author's abstract)
W89-13165

WASTE STABILIZATION IN MULTILAYER AQUIFERS BY OPTIMAL HYDRAULIC CONTROL.
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-13166

ELECTRICAL RESISTIVITY OF THE VADOSE ZONE--FIELD SURVEY.
Rhode Island Univ., Kingston. Dept. of Geology.
For primary bibliographic entry see Field 7B.
W89-13167

APPROACH TO THE FIELD STUDY OF HYDRAULIC GRADIENTS IN VARIABLE-SALINITY GROUND WATER.
Geological Survey, Tampa, FL.
J. J. Hickey.
Ground Water GRWAAP, Vol. 27, No. 4, p 531-539, July-August, 1989. 8 fig, 18 ref.

Descriptors: *Underground waste disposal, *Path of pollutants, *Injection wells, *Hydraulic gradient, *Saline water, *Groundwater, Unconfined aquifers, Coastal aquifers.

Understanding what can and cannot be determined about hydraulic gradients in field studies of variable-salinity groundwater is becoming increasingly important because of the use of subsurface injection as a waste-disposal method in saline aquifers throughout the country. A field study approach is proposed for reliably estimating hydraulic gradients in subregions within a region of variable-salinity groundwater. It is based upon Hubbert's concept about the kind of density distributions that are required for groundwater to have a potential. The approach consists of dividing a region of variable-salinity groundwater into subregions with vertical and lateral variations in density before determining magnitude and direction of hydraulic gradients. Subregions with constant density and subregions with only vertical variations in density according to Hubbert can have a potential; because of this, hydraulic gradients in such subregions may be reliably estimated. Subregions with vertical and lateral variations in density according to Hubbert may not have a potential; because of this, hydraulic gradients in such subregions cannot be reliably estimated. The approach was applied to an unconfined coastal aquifer that is used for subsurface injection. As the two applications show, the analysis of water levels and pressures from subregions with constant or approximately constant density and the analysis of pressures from subregions with only vertical variations in density provide simple and direct means for deducing the characteristics of hydraulic gradients within a region of variable-salinity groundwater. (Author's abstract)
W89-13168

GROUND-WATER QUALITY VARIATIONS IN A SILTY ALLUVIAL SOIL AQUIFER, OKLAHOMA.
California Univ., Davis. Dept. of Civil Engineering.
B. L. Hoyle.
Ground Water GRWAAP, Vol. 27, No. 4, p 540-549, July-August, 1989. 6 fig, 4 tab, 17 ref.

Descriptors: *Network design, *Monitoring, *Path of pollutants, *Alluvial aquifers, *Groundwater quality, *Silt, *Conductance, Bicarbonates, Seasonal variation, Oklahoma, Carbon dioxide.

Sixteen wells in a residential area in central Oklahoma were monitored from mid-April 1986 to early February 1987 to characterize natural water quality variations in a shallow, fine-grained alluvial soil aquifer. The wells are in four clusters, each with four wells, which range in depth from 8 to 14 ft. Two clusters are adjacent to a row of large deciduous trees and two are in grass-covered areas. Considerable spatial and seasonal variations occurred in bicarbonate (the major ion in the groundwater) and in electrical conductance. Both parameters were generally higher in wells adjacent to the trees than in the grassy areas. Carbon dioxide partial pressure values calculated for groundwater samples ranged from 10 2.34 to 10 0.42 atm. For a given pH, PCO2 values were higher in the shallower wells under the trees than in grassy areas. These data suggest that more carbon dioxide was produced by tree resulting in higher bicarbonate concentrations and conductances. Statistical analyses of conductance and bicarbonate data indicated that sample variances were not always equal and that sample distributions were either normal, skewed, or polymodal. These results violate the assumptions of normal distribution and homogeneous variances underlying parametric statistical tests, such as Student's tests, which some regulatory agencies use to compare sample means. Results of this study suggest that more than one well is required to characterize background water quality, and that innovative statistical methods are needed to evaluate monitoring data. (Author's abstract)
W89-13169

APPLICATION AND COMPARISON OF SHALLOW SEISMIC METHODS IN THE STUDY OF AN ALLUVIAL AQUIFER.
Nebraska Univ., Lincoln. Conservation and Survey Div.
For primary bibliographic entry see Field 7B.
W89-13170

COMPUTING WELL HYDRAULICS SOLUTIONS.
California Univ., Irvine. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W89-13171

OXYGEN-ISOTOPE COMPOSITION OF GROUND WATER AND SECONDARY MINERALS IN COLUMBIA PLATEAU BASALTS: IMPLICATIONS FOR THE PALEOHYDROLOGY OF T₁'E PASCO BASIN.
Geological Survey, Reston, VA.
P. P. Hearn, W. C. Steinkampf, D. G. Horton, G. C. Solomon, and L. D. White.
Geology GLGYBA, Vol. 17, No. 7, p 606-610, July 17 1989. 6 fig, 1 tab, 19 ref.

Descriptors: *Paleohydrology, *Groundwater movement, *Groundwater, *Groundwater recharge, *Isotope studies, *Minerals, *Aquifers, Groundwater basins, Columbia Plateau, Pasco Basin, Hanford Reservation, Basalts, Meteoric water, Orography.

Concentrations of O18 and deuterium in groundwaters beneath the Hanford Reservation, Washington State, suggest that the meteoric waters recharging the basalt aquifers have been progressively depleted in these isotopes since at least Pleistocene time. This conclusion is supported by oxygen-isotope analyses of low-temperature secondary minerals filling vugs and fractures in the basalts, which are used to approximate the O18 content of groundwater at the time the mineral assemblage formed. A fossil profile of the change in O18 values projected for groundwater in a 1500 m vertical section beneath the reservation suggests that the vertical mixing of shallow and deep groundwater indicated by present-day hydrochemical data was also occurring at the time secondary minerals formed in the basalt aquifers (late Miocene-Pliocene). These data also suggest that a unidirectional depletion of O18 and deuterium recorded in Pleistocene groundwaters may have extended considerably further back in time. This shift is tentatively attributed to the orographic depletion of O18 associated with the progressive uplift of the Cascade RAnge since the middle Miocene. The results demonstrate that oxygen-isotope analyses of secondary minerals in aquifers can provide useful insights into hydrologic and climatic processes extending over geologically long periods of time. (Peters-PTT)
W89-13183

ISOTOPIC EVIDENCE FOR PALEOHYDROLOGIC EVOLUTION OF GROUND-WATER FLOW PATHS, SOUTHERN GREAT PLAINS, UNITED STATES.
Texas Univ., Austin. Bureau of Economic Geology.
A. R. Dutton, and W. W. Simpkins.
Geology GLGYBA, Vol. 17, No. 7, p 653-656, July 17 1989. 5 fig, 25 ref. DOE Contract DE-AC97-83-WM46651.

Descriptors: *Paleohydrology, *Groundwater movement, *Great Plains, *Isotope studies, *Geohydrology, *Confined aquifers, *Groundwater recharge, Groundwater divide, Aquifers, Meteoric water, Deuterium, Erosion, Pecos River valley, Canadian River valley, New Mexico, Geomorphology, High Plains Aquifer, Potentiometric level, Climate effects.

A confined aquifer in Triassic Dockum Group sandstone beneath the southern Great Plains was isolated from hypothesized paleorecharge areas in eastern New Mexico by Pleistocene erosion of the Pecos and Canadian river valleys and formation of hydrologic divides. Truncation of the flow system left meteoric water in the confined aquifer with mean changes in D and O18 values that are 17% and 2.0%, respectively, lighter than those in the overlying High Plains aquifer. Thick upper Dockum mudstone retards downward flow from the High Plains aquifer, which has been recharged by isotopically heavy precipitation during the Holocene. Recharge to the confined aquifer occurred at altitudes of 1600 to 2200 m in proximal dockum sandstone facies which have since eroded in eastern New Mexico, at a mean temperature 3 C cooler than the present temperature across the southern High Plains. Effects of Pleistocene climatic change on isotopic composition of Dockum groundwater could be superposed over geomorphologic effects. (Author's abstract)
W89-13185

ESTABLISHING AND MEETING GROUND WATER PROTECTION GOALS IN THE SUPERFUND PROGRAM.
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5E.
W89-13200

USING MODELS TO SOLVE GROUND WATER QUALITY PROBLEMS.
For primary bibliographic entry see Field 5G.
W89-13206

USE OF MULTIVARIATE MODELING TO ESTIMATE IMPACTS OF GROUNDWATER WITHDRAWALS ON STREAMFLOW FOR THE CAMAS CREEK BASIN.
Idaho Univ., Moscow. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W89-13316

SIMULATION OF STEADY-STATE GROUNDWATER MOVEMENT AND SPRING FLOW IN THE UPPER FLORIDAN AQUIFER OF COASTAL CITRUS AND HERNANDO COUNTIES, FLORIDA.
Geological Survey, Tampa, FL. Water Resources Div.
D. K. Yobbi.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4036, January 1989. 33p, 11 fig, 6 tab, 20 ref.

Descriptors: *Model studies, *Geohydrology, *Florida, *Floridan Aquifer, Computer models, Potentiometric level, Aquifer characteristics, Water yield.

A digital groundwater flow model was developed to approximate steady-state predevelopment flow conditions in the Upper Floridan aquifer of coastal west-central Florida. The aquifer is the major source of water and natural spring flow in the area. The aquifer was simulated as a one-layer system with constant vertical recharge and discharge rates. Calibrated transmissivities ranged from 8,640 sq ft/day in the northern part of the area to nearly

13,000,000 sq ft/day near large springs. Calibrated inflows were about 2,708 cu ft/sec; of this, about 2,565 cu ft/sec discharged as natural spring flow and 137 cu ft/sec discharged as upward leakage along the coast. The model was used to show how the system might respond to large manmade stresses. Withdrawal of 116 cu ft/sec from a hypothetical regional well field resulted in potentiometric-surface drawdowns ranging from 0.1 to 1.7 ft and declines of generally less than 0.2 ft along the coast. Total spring flow decreased 5%, and the effect on individual springs varied from 0.1 to 8.0%. Withdrawal of 62 cu ft/sec from the 4-sq-mi node at each spring resulted in six of seven springs to the south of the Chassahowitzka River contributing 50% of their flow to pumpage. Springs located north of the Chassahowitzka River contributed as much as 18% of their flow to pumpage. (USGS)
W89-13324

GEOHYDROLOGY AND SUSCEPTIBILITY OF MAJOR AQUIFERS TO SURFACE CONTAMINATION IN ALABAMA; AREA 4.
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-13325

INVESTIGATION OF SHALLOW GROUNDWATER CONTAMINATION NEAR EAST FORK POPLAR CREEK, OAK RIDGE, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-13329

HYDROGEOLOGY OF THE CROTON-OSSINING AREA, WESTCHESTER COUNTY, NEW YORK.
Geological Survey, Albany, NY. Water Resources Div.
R. J. Reynolds.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $19.00, microfiche $3.00. USGS Water-Resources Investigations Report 87-4159, 1988. 5 fig, 20 ref.

Descriptors: *Geohydrology, *New York, *Maps, *Groundwater, *Aquifers, *Groundwater level, Areal hydrogeology, Geologic mapping, Glacial drift, Land use.

The hydrogeology of a 29-sq-mi area surrounding the village of Croton-on-Hudson, New York, is summarized on 6 sheets at 1:12,000 scale that show locations of wells and test holes, surficial geology, geologic sections, bedrock geology, land use, and soil permeability. The primary stratified-drift aquifer in this area is the Croton River aquifer, which consists of outwash sand and gravel that partly fills the Croton River valley from the New Croton Dam to the Hudson River--a distance of approximately 3 miles. The valley is narrow and ranges in width from 100 to 1,900 ft, and its v-notch bedrock floor ranges from 30 to 50 ft below sea level. Detailed hydrogeologic studies during 1936-38 showed the stratigraphy to consist of an upper water-table aquifer with a saturated thickness of about 35 ft, underlain by a silt and clay confining unit 8 to o0 ft in thickness that in turn is underlain by a lower confined outwash aquifer up to 40 ft thick. Aquifer-test data and laboratory permeability tests show that the average hydraulic conductivity of the upper outwash aquifer is 475 ft/d, and that of the lower confined aquifer is about 300 ft/d. The aquifer is recharged through direct precipitation, runoff from adjacent hillsides, and leakage under the new Croton Dam. Previous studies estimate the average leakage under the dam to be 0.65 Mgal/d and the total average daily recharge to the aquifer between New Croton Dam and Quaker Bridge to be 1.73 Mgal/d. (USGS)
W89-13330

CONSTRUCTION, GEOLOGIC, AND GROUNDWATER DATA FOR OBSERVATION WELLS NEAR THE SHELBY COUNTY LANDFILL, MEMPHIS, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
M. W. Bradley.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-486, 1989. 32p, 4 fig, 2 tab, 1 ref.

Descriptors: *Landfills, *Water pollution sources, *Path of pollutants, *Observation wells, *Alluvial aquifers, *Well construction, *Tennessee, Water level, Data acquisition, Groundwater pollution, Lithology, Shelby County, Memphis.

Forty-one observation wells and two stratigraphic test holes were drilled near the Shelby County landfill in east Memphis Tennessee. These wells were installed as part of an investigation on possible vertical leakage of groundwater from the alluvial aquifer into the Memphis Sand aquifer. The alluvial aquifer consists of about 45 to 55 ft of alluvial silt, sand, and gravel. This is separated from the underlying Memphis sand aquifer by about 30 to 60 ft of silt, silty sand, and clay in the confining layer. Thirty wells completed in the alluvium were generally less than 50 ft deep. The depth to the water table ranged from about 15 to more than 45 ft below land surface. Four observation wells were completed in the upper part of the Memphis Sand aquifer. Water levels in the Memphis Sand aquifer were generally 35 to 40 ft below land surface. (USGS)
W89-13335

HYDROLOGIC DATA FOR PALEOZOIC ROCKS IN THE UPPER COLORADO RIVER BASIN, COLORADO, UTAH, WYOMING, AND ARIZONA.
Geological Survey, Denver, CO. Water Resources Div.
A. L. Geldon.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $33.50, microfiche $4.00. USGS Open-File Report 89-59, June 1989. 219p, 1 fig, 5 tab, 50 ref.

Descriptors: *Geohydrology, *Colorado, *Utah, *Wyoming, *Arizona, *Hydrologic data, Data collections, Colorado River basin, Paleozoic era.

This report contains data used to interpret the hydrology of Paleozoic rocks in the Upper Colorado River Basin under the U.S. Geological Survey's Regional Aquifer-System Analysis program. The study area includes the drainages of the Green and Colorado Rivers from their headwaters to Lees Ferry, Arizona. Hydrologic data presented in this report include artesian yields from wells and springs, and values of porosity, intrinsic permeability, and hydraulic conductivity determined by laboratory analyses and aquifer tests. (USGS)
W89-13338

HYDROGEOLOGY AND SIMULATED EFFECTS OF GROUNDWATER DEVELOPMENT ON AN UNCONFINED AQUIFER IN THE CLOSED BASIN DIVISION, SAN LUIS VALLEY, COLORADO.
Geological Survey, Denver, CO. Water Resources Div.
G. J. Leonard, and K. R. Watts.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $7.25, microfiche $4.00. USGS Water-Resources Investigations Report 87-4284, June 1989. 41p, 16 fig, 5 tab, 45 ref.

Descriptors: *Geohydrology, *Colorado, *Computer models, *Groundwater, *Unconfined aquifers, *Evapotranspiration, San Luis Valley project, Salvaged water, Closed basins, Confined aquifers, Leakage, Hydrologic budget.

Wells completed in an unconfined aquifer in the Closed Basin Division of the San Luis Valley Project, Colorado, are expected to provide about 101,800 acre-ft of groundwater/year to the Rio Grande when this project is completed. Lowering of groundwater levels in the unconfined aquifer is expected to decrease the quantity of groundwater that is lost by evapotranspiration. The aquifer system, which consists of an unconfined aquifer that is 50 to 130 ft thick, overlies a thick, leaky confined aquifer. Groundwater moves from the edge of the valley toward a topographic low near the center of the Closed Basin Division, where it is lost by evapotranspiration. A two-dimensional groundwater flow model was used to evaluate the effects of projected withdrawal of about 141 cu ft/sec by 168 wells throughout a 20-year period. The simulated pumpage resulted in a projected drawdown greater than 0.1 ft in the water-levels of the unconfined aquifer over an area of about 370 sq mi. Maximum simulated drawdown was 25 ft. Simulations indicate that about 66% of the water to be withdrawn from the unconfined aquifer would be derived from decreases of evapotranspiration, 26% from induced leakage from an underlying confined aquifer, and 8% from storage of the unconfined aquifer. Model simulations were based only on withdrawals from wells completed in the unconfined aquifer. Pumpage from the confined aquifer was not simulated. Upward leakage from the confined aquifer predicted by the model, results from the simulated declines of the potentiometric surface in the unconfined aquifer. (USGS)
W89-13339

GEOHYDROLOGY OF THE ALLUVIUM AND TERRACE DEPOSITS OF THE NORTH CANADIAN RIVER FROM OKLAHOMA CITY TO EUFAULA LAKE, CENTRAL OKLAHOMA.
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. S. Havens.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4234, 1989. 32p, 12 pl, 14 ref.

Descriptors: *Alluvial aquifers, *Geohydrology, *Oklahoma, *Model studies, Digital models, Surface-groundwater relations.

A 1,835-sq mi geohydrologic system was defined along the North Canadian River between Lakes Overholser and Eufaula, Oklahoma. The major aquifers are: The Quaternary alluvial and terrace aquifer along the North Canadian River, the Permian Garber-Wellington aquifer in the west; and the Pennsylvanian Vamoosa-Ada aquifer in the east. The Garber-Wellington and Vamoosa-Ada aquifers are in hydraulic connection with the overlying alluvial and terrace aquifer. Shales divide the Garber-Wellington aquifer into an upper zone, generally unconfined, and a lower zone, not connected with overlying aquifers. Municipal and industrial pumping from the Garber-Wellington lower zone affects the alluvial and terrace aquifer very little. North Canadian River baseflow for the studied reach was approximately 264 cu ft/sec and evapotranspiration was about 60 cu ft/sec. Recharge rates ranged from 1.7 inches on the west to 7.0 inches on the east. Withdrawal ranged from 2,107 in 1942 to 21,415 acre-ft/yr in 1982. The alluvial and terrace aquifer was modeled using a finite-difference approximation method. The horizontal hydraulic conductivity for the steady-state simulations was 310 ft/day. For the transient simulation, a specific yield of 15% was used. Estimated water in storage was 1,940,000 acre-ft in 1942; 1,910,000 acre-ft in 1973; and 1,890,000 acre-ft in 1982. The projected water in storage in both 1993 and 2020 was 1,890,000 acre-ft. (USGS)
W89-13341

METHODS FOR ESTIMATING MONTHLY STREAMFLOW CHARACTERISTICS AT UNGAGED SITES IN WESTERN MONTANA.
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-13343

REASSESSMENT OF THE GEORGETOWN LIMESTONE AS A HYDROGEOLOGIC UNIT OF THE EDWARDS AQUIFER, GEORGETOWN AREA, TEXAS.
Geological Survey, Austin, TX. Water Resources Div.

L. F. Land, and M. E. Dorsey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $8.25, microfiche $4.00. USGS Water-Resources Investigations Report 88-4190, 1988. 49p, 28 fig, 1 tab, 8 ref.

Descriptors: *Aquifers, *Surface-groundwater relations, *Groundwater recharge, *Water quality, *Streamflow, *Aquifer testing, *Texas, Streams, Hydraulic properties.

A reassessment of the uppermost geologic unit of the Edwards aquifer, the Georgetown Limestone, to determine if it should continue to be classified as a unit of the Edwards aquifer, was conducted in the Georgetown area of Texas using (1) data from six surveys of streamwater gains and losses and groundwater levels, (2) aquifer tests at three clusters of test wells, and (3) variation in water quality characteristics to indicate groundwater circulation. The surveys did not show a pattern of corresponding streamflow gains and losses with positive (upward) and negative (downward) head differentials, respectively, between the main water-bearing zone of the Edwards aquifer and the streams. A consistent and corresponding pattern was shown only for the subreach containing Berry Springs. The aquifer test consisted of 'slug' test analyses to determine the transmissive characteristics of the Georgetown Limestone and produced hydraulic conductivity values ranging from 1.4 X 10 to the minus eight to 2.8 X 10 to the minus nine cm/sec at four of the six test wells. The other two test wells did not produce data suitable for conventional aquifer-test analysis. An analysis of the water quality characteristics indicates that the Edwards Limestone and the streams have a significant hydraulic connection but the groundwater circulation between the Edwards Limestone and the Georgetown Limestone is very limited. The only area where a high degree of hydraulic connection between the main water bearing zone of the Edwards aquifer and the streams was found is near the updip limits of the Georgetown Limestone where a nearby major fault occurs and where major springs have developed. These findings indicate that the Georgetown Limestone does not function as a unit of the Edwards aquifer but as a regional confining bed with localized avenues that allow flow to and from the underlying Edwards aquifer. (USGS)
W89-13345

OPERATING MANUAL FOR THE R200 DOWNHOLE RECORDER WITH TANDY 102 RETRIEVER.
Geological Survey, Stennis Space Center, MS. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-13346

GEOLOGIC AND HYDROLOGIC DATA FOR THE RUSTLER FORMATION NEAR THE WASTE ISOLATION PILOT PLANT, SOUTHEASTERN NEW MEXICO.
Geological Survey, Albuquerque, NM. Water Resources Div.
S. F. Richey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $11.25, microfiche $4.00. USGS Open-File Report 89-32, May 1989. 72p, 3 fig, 2 tab, 1 ref.

Descriptors: *New Mexico, *Waste disposal, *Geohydrology, *Radioactive waste disposal, Water level, Well data, Geologic formations, Geologic control, Structural geology.

The U.S. Geological Survey is investigating the geohydrology in the vicinity of the Waste Isolation Pilot Plant in southeastern New Mexico. Data presented were compiled in support of a regional groundwater flow model. The data include water level measurements obtained from the U.S. Geological Survey's Groundwater Site-Inventory and OMNIANA data bases and stratigraphic information interpreted from commercial geophysical logs. (USGS)
W89-13348

EVALUATION OF METHODOLOGY FOR DELINEATION OF PROTECTION ZONES AROUND PUBLIC-SUPPLY WELLS IN WEST-CENTRAL FLORIDA.
Geological Survey, Tallahassee, FL. Water Resources Div.
J. Vecchioli, J. D. Hunn, and W. R. Aucott.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4051, 1989. 123p, 51 fig, 8 tab, 64 ref.

Descriptors: *Geohydrology, *Water pollution prevention, *Groundwater pollution, *Florida, Well regulations, Water quality control, Path of pollutants.

Public-supply wells in the west-central Florida area of Citrus, Hernando, Pasco, Hillsborough, and Pinellas Counties derive their supply solely from the Floridan aquifer system. In much of this area, the Floridan is at or near land surface and vulnerable to contamination. Recognizing this potential threat to the aquifer, the Florida Department of Environmental Regulation (FDER) recently promulgated regulations providing for the delineation of protection zones around public-supply wells that tap vulnerable aquifers, such as the Floridan in west-central Florida. This report evaluates the methodology for delineation of protection zones for public supply wells in west-central Florida in accordance with the methods detailed in the FDER regulations. Protection zones were delineated for public supply wells or well fields that are permitted an average daily withdrawal of 100,000 gal or more from the Floridan aquifer system where it is unconfined or leaky confined. Leaky confined, as used in FDER regulations describe conditions such that the time for a particle of water to travel vertically from the water table to the top of the Floridan is 5 years or less. Protection zones were delineated by using a radial volumetric-displacement model that simulated 5 years of permitted-rate withdrawal. Where zones overlapped, such as for well fields, composite protection zones in shapes that varied according to the configuration of well arrays were delineated on maps. (USGS)
W89-13350

WATER LEVEL MAPS OF THE MISSISSIPPI RIVER VALLEY ALLUVIAL AQUIFER IN EASTERN ARKANSAS, 1986.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-13351

METHODOLOGY FOR ASSESSMENT OF CONTAMINATION OF THE UNSATURATED ZONE BY LEAKING UNDERGROUND STORAGE TANKS.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W89-13352

WATER RESOURCES ACTIVITIES IN FLORIDA, 1988-89.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-13358

STABLE-ISOTOPE INVESTIGATION OF VAPOR TRANSPORT DURING GROUNDWATER RECHARGE IN NEW MEXICO.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W89-13359

USE OF AEROMAGNETIC DATA TO DEFINE BOUNDARIES OF A CARBONATE-ROCK AQUIFER IN EAST-CENTRAL NEVADA.
Geological Survey, Carson City, NV.
R. W. Plume.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. In: USGS Water Supply Paper 2330, Selected Papers in the Hydrologic Sciences, 1987, 1988. p 1-10, 4 fig, 17 ref. Seymour Subitzky, ed.

Descriptors: *Carbonate rocks, *Flow system, *Groundwater, *Nevada, *Magnetic studies, Aquifers, Boundaries, Geophysics, Granites.

Aeromagnetic data were used to define boundaries for a part of a groundwater flow system in eastern Nevada. In this area, the upper Precambrian and Paleozoic stratigraphic section consists of about 40,000 ft of clastic and carbonate sedimentary rocks. The flow system is contained within the part of this section that is dominated by carbonate rocks. Two models of subsurface geology based on interpretation of aeromagnetic data indicate that in the northern part of White River Valley the flow system is about 25 miles wide and is bounded on the east and west by Cretaceous and Tertiary granitic intrusions. In between, the stratigraphic section is underlain by either Precambrian basement or by younger granitic rocks. Although both models are considered geologically reasonable, the Precambrian basement model is favored because the configuration of the basement surface seems to coincide with inferred fault offsets of the base of the stratigraphic section. This suggests that stratigraphic thickness can be used as a reasonable approximation for maximum aquifer thickness in the northern part of the White River flow system. (Thacker-USGS, WRD)
W89-13362

GROUNDWATER HYDROLOGY AND SIMULATED EFFECTS OF DEVELOPMENT IN SMITH CREEK VALLEY, A HYDROLOGICALLY CLOSED BASIN IN LANDER COUNTY, NEVADA.
Geological Survey, Carson City, NV.
J. M. Thomas, S. M. Carlton, and L. B. Hines.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Professional Paper 1409-E, 1989. 57p, 25 fig, 10 tab, 39 ref.

Descriptors: *Alluvial aquifers, *Nevada, *Closed basins, *Groundwater basins, *Model studies, *Geohydrology, *Groundwater movement, Groundwater budget, Hydrologic models, Mathematical models, Phreatophytes.

Smith Creek Valley, Nevada is a hydrologically closed, single-valley groundwater flow system in the Great Basin. Gravity data indicate that the basin-fill aquifer is a complex bowl-shaped accumulation of unconsolidated alluvial and lacustrine deposits having a maximum thickness of 5,500 ft. Recharge estimates range from, 8,300 acre-ft to 9,600 acre-ft/yr and the natural discharge is an estimated 8,300 acre-ft/yr. Groundwater pumpage (mostly agricultural) totaled less than 700 acre-ft/year as of 1983. Calibration of a groundwater flow model showed that water levels throughout the basin are controlled by the rate of natural discharge. The flow model was used to simulate possible long-term effects of applied stresses for selected development scenarios. Simulations indicate that natural discharge can be efficiently reduced with a maximum drawdown of less than 20 ft averaged over a 2-sq-mi model block, by pumping strategically located wells at a rate equal to the sustained yield. Doubling or varying the pumping rate resulted in more rapid reduction of natural discharge but produced greater simulated water-level declines. Moving the pumping to more concentrated centers near the discharge area resulted in less efficient reduction of natural discharge and produced greater simulated water-level declines. (Thacker-USGS)
W89-13363

GROUNDWATER QUALITY IN DOUGLAS COUNTY, WESTERN NEVADA.
Geological Survey, Carson City, NV.
K. T. Garcia.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4269,

1989. 107p, 29 fig, 7 tab, 30 ref.

Descriptors: *Douglas County, *Land use, *Urbanization, *Groundwater, *Water quality, *Nevada, Antelope Valley, Carson Valley, Minden-Gardnerville, Sampling.

A 182% increase in population within the last 10 years in Douglas County, Nevada, has raised concerns by county officials as to the possible effects land development may have on groundwater quality. Most groundwater in Douglas County meets the State of Nevada drinking water standards. Of the 333 water samples used in this analysis, 6 equaled or were greater than the drinking water standards for sulfates, 44 for fluoride, 4 for dissolved solids, 5 for nitrate as nitrate, 12 for arsenic, 33 for iron, and 18 for manganese. Groundwater in the west-central, northern, and northeastern part of Carson Valley is influenced by geothermal water. Some areas in the county may have septic-tank effluent contaminating the groundwater. Temporal changes in most municipal wells showed no overall trend for dissolved-solids and nitrate concentrations spanning the years 1969-83. However, a municipal well in the Topaz Lake area has shown a general increases in the nitrate concentration from 1961 to 1984, but the concentration does not exceed the drinking-water standard. A future groundwater quality monitoring program in Douglas County would include periodic sampling of primary or heavily pumped wells, long-term trend wells, and supplemental wells. (Thacker-USGS)
W89-13364

DATA ON GROUNDWATER QUALITY, CARSON VALLEY AND TOPAZ LAKE AREAS, DOUGLAS COUNTY, NEVADA, FOR YEAR ENDING SEPTEMBER 1986.
Geological Survey, Carson City, NV.
C. E. Thodal.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-453, 1989. 55p, 5 fig, 10 tab, 29 ref.

Descriptors: *Carson Valley, *Groundwater quality, *Nevada, *Water quality, Antelope Valley, Douglas County, Monitoring, Pollutant identification, Topaz Lake.

Douglas County, Nevada encompasses 708 sq mi and has been one of the fastest growing counties in the Nation, according to the 1980 census. This rapid population growth has led to concern about the present and future impacts of development upon the groundwater. A network of 33 wells was recently established (1985) in the Carson Valley and Topaz Lake areas of Douglas County to characterize the current groundwater quality and its seasonal variability and to monitor temporal responses to changing land-use activities. This report presents data collected from that network during November 1985 through September 1986. The primary drinking water standard was exceeded for fluoride at two domestic wells, for nitrate-nitrogen at one domestic well, and for arsenic in one nondomestic shallow monitoring well. Secondary drinking water standards were exceeded as follows: pH at one public-supply well and one domestic well; sulfate at one shallow monitoring well; and manganese at three shallow monitoring wells and one public-supply well. Concentrations of unidentified organic compounds were estimated by gas chromatograph and flame ionization detector for groundwater samples collected from 30 network wells. Seven wells (2 domestic and 5 nondomestic) had concentrations greater than 10 micrograms/L relative to the internal standard compound perdeuteronaphthalene. (Thacker-USGS)
W89-13365

GROUNDWATER QUALITY ASSESSMENT OF THE DELMARVA PENINSULA, DELAWARE, MARYLAND, AND VIRGINIA--ANALYSIS OF AVAILABLE WATER QUALITY DATA THROUGH 1987.
Geological Survey, Towson, MD. Water Resources Div.
P. A. Hamilton, R. J. Shedlock, and P. J. Phillips.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-34, 1989. 71p, 33 fig, 13 tab, 51 ref, append.

Descriptors: *Coastal aquifers, *Water quality, *Groundwater quality, Geochemistry, Nitrates, Organic compounds.

Regional water quality conditions were analyzed on the basis of available data for the Delmarva Peninsula. A summary of 3 Federal, 5 State, and 14 local agencies, as well as various nonprofit organizations and universities, serving as repositories for water quality data is presented. Also included is information describing the range of chemical constituents, the ease of retrieving the data, and general characteristics of the data for use in a regional groundwater quality assessment. Certain characteristics of the available data limit their usefulness for a regional assessment of groundwater. These include a (1) lack of information on quality control; (2) inconsistent sampling; preservation, and analytical techniques used among and within agencies; (3) the clustering of sampling wells around known or suspected areas of contamination, which can impose a bias on water quality assessments; and (4) lack of information on sampling locations, well depths, well construction, and aquifer characteristics. Despite these limitations, the analysis provides a foundation for more detailed regional assessments of water resources on the Delmarva Peninsula and highlights areas where pertinent data are needed. Results of the analysis indicate that data on trace element and organic compound concentrations in groundwater in the Delmarva Peninsula are scarce, whereas data for nitrate, iron, and manganese concentrations are relatively abundant. The data indicate that elevated concentrations of nitrate, iron, and manganese are prevalent in water throughout the surficial aquifer--an aquifer that not only is important in recharging the underlying confined aquifer system, but in supplying drinking water to the majority of Delmarva Peninsula residents. (USGS)
W89-13366

TEST WELL SF-1A, 1B, 1C, AND SF-2A, 2B, 2C, SANTA FE COUNTY, NEW MEXICO.
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-13369

HYDROGEOLOGIC CHARACTERISTICS OF THE VALLEY-FILL AQUIFER IN THE ARKANSAS RIVER VALLEY, PUEBLO COUNTY, COLORADO.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-13370

HYDROGEOLOGIC CHARACTERISTICS OF THE VALLEY-FILL AQUIFER IN THE ARKANSAS RIVER VALLEY, CROWLEY AND OTERO COUNTIES, COLORADO.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-13371

HYDROGEOLOGIC CHARACTERISTICS OF THE VALLEY-FILL AQUIFER IN THE ARKANSAS RIVER VALLEY, PROWERS, COLORADO.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-13372

HYDROLOGICAL AND METEOROLOGICAL DATA FOR AN UNSATURATED ZONE STUDY NEAR THE RADIOACTIVE WASTE MANAGEMENT COMPLEX, IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO--1985-86.
Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 5E.
W89-13373

SELECTED GROUNDWATER DATA, CHESTER COUNTY, PENNSYLVANIA.
Geological Survey, Malvern, PA. Water Resources Div.
R. A. Sloto.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-217, July 1989. 198p, 2 pl, 1 fig, 16 tab, 9 ref.

Descriptors: *Groundwater data, *Pennsylvania, *Chester County, *Water quality, *Water resources data, Water pollution sources, Pesticides, Water level.

Selected groundwater data for Chester County, Pennsylvania, are presented. Hydrologic data are given for 2,877 wells and 32 springs. Chemical analyses are given for physical properties, common ions, nutrients, metals and other trace constituents, radionuclides, volatile organic compounds, acid organic compounds, base-neutral organic compounds, organochloride insecticides, organophosphorous insecticides, organic acid herbicides, triazine herbicides, and other organic compounds. Water levels are given for 48 observation wells measured monthly during 1936-1985. (USGS)
W89-13374

SUBSURFACE STORAGE OF LIQUIDS IN THE FLORIDAN AQUIFER SYSTEM IN SOUTH FLORIDA.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 5E.
W89-13375

PRELIMINARY ANALYSIS OF THE SHALLOW GROUNDWATER SYSTEM IN THE VICINITY OF THE GRAND CALUMET RIVER/INDIANA HARBOR CANAL, NORTHWESTERN INDIANA.
Geological Survey, Indianapolis, IN. Water Resources Div.
L. R. Watson, R. J. Shedlock, K. J. Banaszak, L. D. Arihood, and P. K. Doss.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Paper copy $7.50, microfiche $4.00. USGS Open-File Report 88-492, 1989. 45p, 17 fig, 1 tab, 16 ref.

Descriptors: *Geohydrology, *Surface-groundwater relations, *Indiana, *Grand Calumet River, *Indiana Harbor, Water resources data.

The shallow groundwater system in the vicinity of the Grand Calumet River-Indiana Harbor Canal, Indiana was analyzed from June 1985 to May 1986. This analysis was done to obtain detailed information about the physical characteristics of the Calumet aquifer and the shallow groundwater flow system. 36 shallow wells were installed and sediment samples were collected at 26 sites. Water level measurements were made in 45 wells. Data indicate that the aquifer consists of fine-grained to medium-grained sand, locally overlain by slag fill. Aquifer thickness is 0 to 65 ft. This aquifer is underlain by about 100 ft of glacial till and lacustrine clay that overlies carbonate bedrock of Silurian age. Broad, low-relief water table mounds occur between the major surface water drains. The crests of these mounds form major east-west-trending water table divides. Northwest of the Indiana Harbor Canal (IHC), a narrow water table ridge parallels the Lake Michigan shoreline and connects to a somewhat circular, low mound northwest of the IHC. Shallow groundwater generally flows from these water table mounds to the major streams or to Lake Michigan. Groundwater also flows to small ditches, wetlands, and sewer lines. Stream/aquifer relations along the Grand Calumet River/IHC were quite complex. Digital model simulations of a conceptual north-south section near the middle of the study area indicate that discharge of groundwater to small ditches and leaky sewer lines has lowered the water table by several ft from predevelopment levels. Simulations

also indicate that downward leakage to the bedrock may have contributed to the decline in the water table. (USGS)
W89-13376

RADIONUCLIDES IN GROUNDWATER AT THE IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO.
Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-13377

HYDROLOGIC DATA: SOUTH BRANCH CASSELMAN RIVER, GARRETT COUNTY, AND MARSH RUN, WASHINGTON COUNTY, MARYLAND.
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-13379

MEASUREMENTS OF RECHARGE RATES THROUGH AN UNSATURATED GLACIAL TILL BY TRITIUM ANALYSES.
Purdue Univ., Lafayette, IN. Water Resources Research Center.
D. P. Daniels, S. J. Fritz, and D. I. Leap.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-220909/AS. Price codes: A03 in paper copy, A01 in microfiche. Technical Report No. 181, June 1989. 83p, 12 fig, 10 tab, 45 ref. Contract 14-08-0001-G1561. USGS Project G1561-03.

Descriptors: *Geochemistry, *Groundwater recharge, *Stable isotopes, *Water chemistry, *Infiltration rate, *Tritium analysis, *Radioactive tracers, Vadose zone, Glacial till, Indiana, Measurement, Analytical techniques.

Measurement of the penetration depth of bomb-derived tritium is a relatively simple, yet effective method for measuring the average annual recharge rate through the vadose zone. The tritium profile obtained in core BN-1, located on the upland till plain near West Lafayette, Indiana showed a definite low-high-low signal at depth, indicating the position of recharge water derived from 1963/64 precipitation. The recharge rate calculated using the depth of penetration of the 1963/64 peak, as well as by comparing the amount of tritium held in the vadose zone with that available for recharge since 1963/64, is 36 mm/yr (1.4 in/yr). This is in reasonable agreement with Arihood's (1982) estimate of 51 to 114 mm/yr (2 to 4.5 in/yr) for tills, based on his numerical groundwater flow model. Two other cores, located on a slope topographically lower then BN-1, showed no definite reversal in tritium concentration. This is probably due to lateral flow components at these locations. (Wright-Purdue U.)
W89-13381

USE OF GROUND PENETRATING RADAR TO DEFINE RECHARGE AREAS IN THE CENTRAL SAND PLAIN.
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
G. C. Bohling, M. P. Anderson, and C. R. Bentley.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-224885. Price codes: A04 in paper copy, A01 in microfiche. Wisconsin Water Resources Center, Madison, Technical Report WIS WRC 89-01, 1989. 62p, 22 fig, 3 tab, 37 ref. Contract no. 14-08-0001-G1458. USGS Project no. G1458-03.

Descriptors: *Groundwater pollution, *Groundwater recharge, *Agricultural chemicals, *Radar, Ground-penetrating radar, Geophysics, Wisconsin, Central Sand Plain, Water table elevation, Wells.

Contamination of groundwater by agricultural chemicals in the Central Sand Plain has prompted studies of groundwater flow in this region. Because the groundwater system is particularly susceptible to contamination in areas where groundwater recharge occurs, identification of recharge zones can contribute significantly to the effective management of agricultural chemical use. An accurate map of water table elevation (groundwater head) is crucial to identifying the distribution of recharge. The reliability of ground penetrating radar (GPR) as a tool for obtaining high resolution maps of water table elevation was assessed. GPR surveys were performed in the summer and fall of 1987 in Wisconsin's Central Sand Plain with a set of existing water table elevation wells. Sparse subsets of wells in the area were used to calibrate the radar; water table depths obtained from these calibrations were compared to known water table depths in the remaining wells. Three wells are the minimum needed to obtain an estimate of uncertainty in calibration parameters; specifically the radar signal velocity in the subsurface materials and the return time correction factor. Results indicate that, in the study area, three calibrating wells were adequate to give a correlation of 0.99 and a root mean-squared deviation of about 1 foot between radar-predicted and observed water table depths. If several wells distributed throughout a region of interest yield consistent calibration results, radar can be used to produce a map of water table elevation for that region. (Sherman-WWRC)
W89-13382

LOW-FLOW PROFILES OF THE UPPER CHATTAHOOCHEE RIVER AND TRIBUTARIES IN GEORGIA.
Geological Survey, Doraville, GA. Water Resources Div.
R. F. Carter, E. H. Hopkins, and H. A. Perlman.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-0154, 1989. 194p, 3 fig, 12 ref.

Descriptors: *Georgia, *Wastewater dilution, *Flow profiles, *Low flow, *Surface water availability, Discharge frequency, Drainage area, Chattahoochee River.

Low-flow information is provided for use in evaluating the capacity of streams in Georgia to permit withdrawals or to accept waste loads without exceeding the limits of State water-quality standards. The information also will be useful in planning future flow-data collection programs, as well as expediting the work of planners, engineers, and others who use low-flow information. The report is the seventh in a series of reports presenting the results of a low-flow study of all stream basins north of the Fall Line in Georgia. This report covers the upper Chattahoochee River basin. The low-flow characteristic presented is the minimum average flow for 7 consecutive days with a 10-year recurrence interval (7Q10). The data are presented in tables and shown graphically as 'low-flow profiles' (low flow plotted against distance along a stream channel) and as 'drainage-area profiles' (drainage area against distance along a stream channel). Low-flow profiles were constructed by interpolation or extrapolation from points of known low-flow data. Low-flow profiles are included for all stream reaches where low-flow data of sufficient accuracy are available to justify computation of the profiles. Drainage-area profiles are included for all stream basins larger than 5 sq mi, except for those in a few remote areas. Flow records were not adjusted for diversions or other factors that caused measured flows to represent conditions other than natural flow. The 7-day, minimum-flow profile was omitted for stream reaches where natural flow was known to be altered substantially. (USGS)
W89-13384

FLOODS OF OCTOBER 1983 IN SOUTHEASTERN ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
R. H. Roeske, J. M. Garrett, and J. H. Eychaner.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 85-4225-C, 1989. 77p, 96 fig, 96 tab, 57 ref.

Descriptors: *Regional floods, *Flood data, *Floods, *Hydrologic data, *Arizona, *Gila River, Flood peak, Flood frequency, Runoff volume, Flooding, Rainfall, Tropical cyclones, Channel erosion, Flood damage, San Francisco River, San Pedro River, Santa Cruz River, Salt River, New Mexico, Tropical Storm Octave.

Tropical storm Octave off the coast of Baja California, was the main cause of the outstanding floods on the San Francisco, Gila, San Pedro, and Santa Cruz Rivers and other smaller streams in California. The peak discharges at long-term gaging stations on the San Francisco, Gila, and Santa Cruz River and Rillito Creek were the largest since 1915 or earlier. At 19 gaging stations, the floods had recurrence intervals greater than 70 years. Eight lives were lost as a result of the floods, and flood damages were estimated to be $226.5 million. (USGS)
W89-13388

WATER RESOURCES OF THE UPPER BIG WOOD RIVER BASINS, IDAHO.
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-13389

NATIONAL WATER SUMMARY 1986--HYDROLOGICAL CONDITIONS AND GROUNDWATER QUALITY.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-13395

COMPUTATION OF THREE-DIMENSIONAL ADVECTION-DOMINATED SOLUTE TRANSPORT IN SATURATED AQUIFERS.
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W89-13396

DEVELOPMENT OF A COMBINED QUANTITY AND QUALITY MODEL FOR OPTIMAL MANAGEMENT OF UNSTEADY GROUNDWATER FLOW FIELDS.
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W89-13400

CONTRIBUTION OF SUBSOIL AND AQUIFER MICROORGANISMS TO GROUNDWATER QUALITY.
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W89-13406

2G. Water In Soils

UNCERTAINTY IN A PESTICIDE LEACHING ASSESSMENT FOR HAWAII.
California Univ., Berkeley. Dept. of Plant and Soil Biology.
For primary bibliographic entry see Field 5B.
W89-12191

GENERATION OF STREAM RUNOFF IN TILL SOILS.
Uppsala Univ. (Sweden). Dept. of Hydrology.
For primary bibliographic entry see Field 2E.
W89-12194

EFFECTS OF CLIMATE ON POTENTIAL SOIL WATER GAIN FROM SNOWMELT IN STUBBLE AND FALLOW FIELDS.
Montana State Univ., Bozeman. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 3F.
W89-12343

ESTIMATION OF SOIL MOISTURE DEFICITS USING METEOROLOGICAL MODELS AT AN UPLAND MOORLAND SITE IN NORTHERN ENGLAND.
Leeds Univ. (England). School of Geography.
J. G. Lockwood, C. A. Jones, and R. T. Smith.
Agricultural and Forest Meteorology AFMEEB, Vol. 46, No 1/2, p 41-63, April 1989. 14 fig, 2 tab, 19 ref.

Descriptors: *England, *Soil water, *Soil moisture deficiency, *Meteorological data collection, *Model studies, *Water deficit, Mathematical studies, Agricultural hydrology, Numerical models, Estimating.

Soil moisture deficit (SMD) values from the MORECS model of the U.K. Meteorological Office are compared with measurements and further numerical simulations for a moorland site in upland northern England. Meteorological observations at the site were made using an automatic weather station, while soil moisture was measured with a neutron probe. The additional numerical simulations were made using three different models, all based on the Penman-Monteith equation. The first model is a local version of the MORECS model. The second is based on the sparse vegetation model of Shuttleworth and Wallace. The third contains a subroutine to correct for atmospheric stability, since this may be important for wet surfaces. All three models are found to give acceptable estimates of SMD values, as is MORECS. Soil moisture was also modeled using a fine resolution model, but the increase in computer time was not justified by the improvement in soil moisture estimation. (Author's abstract)
W89-12344

WATER TRANSFER THROUGH COTTON PLANTS CONNECTING SOIL REGIONS OF DIFFERING WATER POTENTIAL.
Minnesota Univ., St. Paul. Dept. of Soil Science.
For primary bibliographic entry see Field 2I.
W89-12353

MODEL FOR INORGANIC CONTROL OF PHOSPHATE CONCENTRATIONS IN RIVER WATERS.
Harvard Univ., Cambridge, MA. Dept. of Earth and Planetary Sciences.
For primary bibliographic entry see Field 2K.
W89-12402

SOLUBLE CALCIUM COMPOUNDS MAY AID LOW-VOLUME WATER APPLICATION.
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 3F.
W89-12427

DESALINIZATION OF AN IRRIGATED, MOLE-DRAINED, SALINE CLAY LOAM SOIL.
Agriculture Canada, Lethbridge (Alberta). Research Station.
T. G. Sommerfeldt, and C. Chang.
Canadian Journal of Soil Science CJSSAR, Vol. 67, No. 2, p 263-269, May 1987. 1 fig, 5 tab, 7 ref.

Descriptors: *Land reclamation, *Soil management, *Saline soils, *Mole drainage, *Irrigation, Soil types, Clays, Loam, Conductivity, Sodium, Calcium, Magnesium, Sulfates, Leaching, Saturation, Water quality.

Desalinization of an irrigated, saline, clay loam soil that had been drained with unlined and lined mole drains, at 0.7 m depth, was determined during a 10-yr reclamation period. Within 5 yr the mean electrical conductivity (EC) of the surface 60 cm of soil, for about one-half of the plot area, had been reduced from greater than 8 to less than 4 dS/m. The mean EC for the plot area at the 0-cm to 60-cm and 0-cm to 180-cm depths declined in a logarithmic order with time. Desalinization of the surface 30 cm of soil was greater under the unlined drain regime than under the lined, but at 30-cm to 120-cm depths, desalinization was greater under the lined. The salts were mostly sodium, calcium, and manganese sulfates. Although the unlined mole drains had an average discharge of 24% of that from the lined, the average salt discharged through the unlined drains was 80% of that from the lined ones. The lined drains removed more salts over a greater range of depths. (Author's abstract)
W89-12429

ROLE OF SEASONAL SALT AND WATER FLUXES IN THE GENESIS OF SOLONETZIC B HORIZONS.
Environment Canada, Lethbridge (Alberta). Earth Sciences Div.
S. Fullerton, and S. Pawluk.
Canadian Journal of Soil Science CJSSAR, Vol. 67, No. 4, p 719-730, November 1987. 5 fig, 1 tab, 28 ref.

Descriptors: *Seasonal variation, *Solute transport, *Salts, *Soil water, *Soil genesis, *Saline soils, Flow, Alberta, Soil types, Sodium sulfate, Bicarbonates, Soil temperature, Evaporation, Capillarity, Water table, Freezing.

Seasonal salt and water fluxes into Black Solonetz soils were evaluated at two sites in east-central Alberta. The dominant mode of moisture movement into the soil pedon was by capillary movement of water upwards from the water table. Solonization occurred in the Bntj horizons as a consequence of salt transport; the salts responsible were NaHCO3 and Na2SO4. Seasonal salt and water fluxes were identified at both research sites. From May to November when soil temperatures were above 0 C, capillary movement and evaporation were the major mechanisms responsible for salt transport, concentration, and deposition. From December to March when soil temperatures were below 0 C, water moved upwards from the water table towards the freezing zone depositing salts upon freezing. (Author's abstract)
W89-12430

COMPARISON OF TWO SOIL-WATER MODELS UNDER SEMI-ARID GROWING CONDITIONS.
Agriculture Canada, Ottawa (Ontario). Land Resource Research Centre.
R. De Jong.
Canadian Journal of Soil Science CJSSAR, Vol. 68, No. 1, p 17-27, February 1988. 3 fig, 6 tab, 29 ref.

Descriptors: *Soil water, *Model studies, *Semi-arid lands, *Hydrologic budget, *Soil-water-plant relationships, Crop production, Wheat, Saskatchewan, Temperature, Precipitation, Flow, Hydraulic conductivity, Evapotranspiration, Capillarity.

The Versatile Soil Moisture Budget (VSMB) and the Soil-Plant-Air-Water (SPAW) model were compared and tested against soil-water content data from a long-term experiment in which wheat was grown on fallow land in the semi-arid zone of Saskatchewan. Both models were driven by daily air temperatures and precipitation data. At the expense of requiring more detailed soil and crop information, the SPAW model simulated the water balance and its components in greater detail than the VSMB. Predictions of soil-water contents throughout the growing season with either model corresponded very well with the measured data. The overall mean absolute difference in total soil-water content to a depth of 120 cm was 1.5 cm for the VSMB and 1.2 cm for the SPAW model. Predictions of water distribution in the profile were also satisfactory. A choice between the two models, to be used under semi-arid growing conditions, will depend on the availability of input data and the required level of output. (Author's abstract)
W89-12433

BORON AND SALINITY SURVEY OF IRRIGATION PROJECTS AND THE BORON ADSORPTION CHARACTERISTICS OF SOME SASKATCHEWAN SOILS.
National Hydrology Research Inst., Saskatoon (Saskatchewan).
For primary bibliographic entry see Field 2K.
W89-12434

AVAILABLE WATER-HOLDING CAPACITY MAPS OF ALBERTA, SASKATCHEWAN AND MANITOBA.
Agriculture Canada, Ottawa (Ontario). Land Resource Research Centre.
R. De Jong, and J. A. Shields.
Canadian Journal of Soil Science CJSSAR, Vol. 68, No. 1, p 157-163, February 1988. 3 fig, 2 tab, 13 ref.

Descriptors: *Water-carrying capacity, *Maps, *Alberta, *Saskatchewan, *Manitoba, *Soil water, Soil texture, Crop production, Model studies, Topography, Geography, Prairies, Soil types.

Available water-holding capacity (AWC) is an important determinant of the agricultural soil capability in areas of dryland agriculture. Information on this soil parameter is needed for the geographical interpretation of soil water and crop modelling results, as well as for land evaluation purposes. However, field measurements of AWCs are time-consuming and expensive, and often not available for large geographical areas. The methodology and results of mapping AWCs in Alberta, Saskatchewan, and Manitoba are presented. Soil landscape maps of the three Prairie provinces, except northern Saskatchewan, are available in digitized form at a scale of 1:1 million. Textural classes of soil parent material, occupying the dominant part of map polygons, are included as part of this computerized information base. AWC maps were derived from the soil landscape maps by substituting AWC classes for parent material textural groups and by assuming that there were no lithological discontinuities. Further work is needed to refine the relationship between AWC and soil factors other than texture. The importance of lithological profile discontinuities ought to be defined. Nevertheless, the present maps are considered useful for the geographical interpretation of soil water and crop modelling analyses. (Doria-PTT)
W89-12435

MEASUREMENT OF NEAR-SURFACE SOIL MOISTURE WITH A HYDROGENOUSLY SHIELDED NEUTRON PROBE.
Alberta Univ., Edmonton. Dept. of Soil Science.
For primary bibliographic entry see Field 7B.
W89-12436

SOIL CHEMICAL CRITERIA FOR IRRIGATION SUITABILITY CLASSIFICATION OF BROWN SOLONETZIC SOILS.
Agriculture Canada, Lethbridge (Alberta). Land Evaluation and Reclamation Branch.
D. R. Bennett.
Canadian Journal of Soil Science CJSSAR, Vol. 68, No. 4, p 703-714, November 1988. 3 fig, 4 tab, 53 ref.

Descriptors: *Soil chemistry, *Soil classification, *Irrigation, *Soil types, Sodium, Adsorption, Alberta, Sulfates, Saturation, Calcium, Root zone, Salinity.

A good statistical relationship was obtained between the exchangeable-sodium ratio and the sodium adsorption ratio (SAR) in Brown Solonetzic and associated soils in southern Alberta. Reliable estimates of the exchangeable-sodium status of these sulfate-rich soils may be anticipated when SAR values are less than 20. Prediction of the exchangeable-sodium status of soils on the basis of SAR values is preferable for both Solonetzic soil and irrigation suitability classification. A saturation extract SAR value of five in the B horizon generally corresponds to an exchangeable calcium to sodium ratio of 10. Saturation extract SAR values of five and 12 are recommended as revised soil chemical criteria for Brown Solonetzic soil and irrigation suitability classification, respectively. SAR values greater than 12 or 13 in the B horizon likely represent an exchangeable-sodium content that seriously impairs water movement in Brown Solonetzic soils under irrigation. Successful, long-term irrigation of numerous Solonetzic soil associa-

tions in the Eastern Irrigation District may be attributed to moderate sodicity levels within the solonetzic B horizon in these soils and the mitigative effects of the electrolyte concentration of irrigation water on soil dispersion. Irrigation suitability evaluations must also consider the frequent occurrence of saline parent material at shallow depth within Solonetzic soil associations and the resulting potential for salinization of the root zone under irrigation. (Author's abstract)
W89-12450

ESTIMATING SPATIAL VARIATIONS OF SOIL WATER CONTENT USING NONCONTACTING ELECTROMAGNETIC INDUCTIVE METHODS.
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 7B.
W89-12451

CLASSIFICATION OF CULTIVATED ESTUARINE ACID SULFATE SOILS IN QUEBEC.
Agriculture Canada, Ottawa (Ontario). Land Resource Research Centre.
C. R. De Kimpe, M. R. Laverdiere, and R. W. Baril.
Canadian Journal of Soil Science CJSSAR, Vol. 68, No. 4, p 821-826, November 1988. 1 fig, 1 tab, 14 ref.

Descriptors: *Soil classification, *Cultivated lands, *Coastal marshes, *Sulfates, *Quebec, *Acidic soils, Sediments, Lime, Leaching, Soil types, Organic matter, Sodium, Calcium.

When drained and cultivated, acid sulfate soils developed on coastal marsh sediments lose some of their specific properties because large amounts of lime are applied before cultivation and sulfate ions are leached out of the profiles. However, these soils still contrast strongly with other Gleysolic soils and their special characteristics should be given more emphasis in the soil classification system, especially for the benefit of soil fertility specialists. Introducing an additional subgroup in the Gleysolic order would highlight a specific soil-forming process, 'thionization,' or sulfuricization, characterized by the accumulation and transformation of sulfides in the soil. The presence of large areas of sulfide-rich parent materials in several provinces would further support this addition. At the family level, deletion of the sulfurous class could be considered, because the soils generally contain a large variety of clay minerals, and jarosite is not the major mineral present. Finally, this proposed change in the soil classification system would be most useful to soil fertility specialists, who would be more aware of the S status of large areas of cultivated soils across the country. (Author's abstract)
W89-12453

ESTIMATING VERTICAL SATURATED HYDRAULIC CONDUCTIVITY FROM SOIL MORPHOLOGY IN ALBERTA.
Agriculture Canada, Ottawa (Ontario). Land Resource Research Centre.
G. M. Coen, and C. Wang.
Canadian Journal of Soil Science CJSSAR, Vol. 69, No. 1, p 1-16, February 1989. 2 fig, 3 tab, 11 ref.

Descriptors: *Vertical flow, *Soil water, *Saturated soils, *Hydraulic conductivity, *Soil properties, *Alberta, Soil surveys, Prairies, Permeameters, Soil types, Mapping, Prediction, Estimating.

Vertical saturated hydraulic conductivity, as an important soil characteristic, should be part of the information displayed on soil survey maps. As rigorous measurement techniques are relatively slow and cumbersome, a rapid procedure for estimating vertical saturated hydraulic conductivity of soils using soil morphology was tested for Prairie conditions. Morphological estimates of vertical saturated hydraulic conductivity were compared to field measurements using an air entry permeameter for 36 sites representing 25 soil series. Eighty-three percent of the estimated values were within one saturated hydraulic conductivity class of the mean measured value. It was concluded that morphological observations are sufficiently accurate to allow field characterization of pedons. In Alberta, in Chernozemic areas, management procedures do not appear to modify strongly the saturated hydraulic conductivity. This in turn allows useful predictions of saturated hydraulic conductivity to be related to soil series concepts and therefore allows extrapolation to manageable tracts of land using map unit concepts. (Author's abstract)
W89-12454

INFLUENCE OF WATER TABLE LEVELS ON METHANE AND CARBON DIOXIDE EMISSIONS FROM PEATLAND SOILS.
McGill Univ., Montreal (Quebec). Dept. of Geography.
T. R. Moore, and R. Knowles.
Canadian Journal of Soil Science CJSSAR, Vol. 69, No. 1, p 33-38, February 1989. 2 fig, 1 tab, 23 ref.

Descriptors: *Groundwater level, *Soil gases, *Water table, *Methane, *Carbon dioxide, *Peat soils, *Soil chemistry, Fens, Bogs, Swamps, Water table decline, Acidity, Soil bacteria, Soil fungi, Flooding, Soil columns, Dissolved organic carbon.

The evolution of carbon dioxide and methane was measured from laboratory columns packed with surface (0-30 cm) materials representing a fen, a bog, and a swamp, and with varying water tables and treated with water containing 10 mg/L dissolved organic carbon. Carbon dioxide evolution increased in a linear relationship as the water table was lowered, ranging from 0.3-0.5 g CO2/sq m/d to 6.6-9.4 g CO2/sq m/d for the water table at 10 cm above and 70 cm below the peat surface, respectively. Methane evolution decreased in a logarithmic relationship as the water table was lowered. The fen showed the highest rates of methane flux (28 mg CH4/sq m/d when inundated) and the bog the lowest (0.7 mg CH4/sq m/d when inundated). These differences appeared to be related to the acidity of the soils and their microbial characteristics. Molar ratios of carbon dioxide:methane evolution increased from 4 to 173 under inundated conditions to $>$ 2500 when the water table was at a depth of 70 cm. (Author's abstract)
W89-12455

CLASSIFICATION OF THE CLIMATE OF ENGLAND AND WALES BASED ON AGROCLIMATIC DATA.
Institute of Terrestrial Ecology, Edinburgh (Scotland).
For primary bibliographic entry see Field 2B.
W89-12609

NONLINEAR STEADY STATE SEEPAGE INTO DRAINS.
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Water Resources and Environmental Engineering.
For primary bibliographic entry see Field 2F.
W89-12632

WATER MOVEMENT IN HORIZONTALLY LAYERED SOILS.
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
Z. Samani, A. Cheraghi, and L. Willardson.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 449-456, June 1989. 6 fig, 1 tab, 14 ref.

Descriptors: *Soil water, *Soil horizons, *Soil profiles, *Percolation, *Hydraulic conductivity, Diffusivity, Capillary water, Wetting, Unsaturated flow, Soil texture.

The water movement in layered soils where fine-textured soil overlays a coarse textured soil has become very important in recent years due to its effect on the movement of pollutants and the distance to which water can percolate in a short time. Previous experiences have shown that when the sublayer is more pervious than the top layer, the wetting front becomes unstable through the second layer and water moves in the form of separate columns rather than uniform unsaturated flow. The purpose of this research was to determine the ratio of hydraulic conductivities at which the wetting front loses its one-dimensionality and breaks into 'fingers.' The result showed that up to a hydraulic conductivity ratio of 20, the wetting front is one-dimensional and movement through the second layer is unsaturated. When the hydraulic conductivity ratio exceeds the value of 20, the wetting front loses its one-dimensionality and the water moves through the second layer in the form of wet columns called 'fingers.' While previous experiences have shown that an increase in initial moisture content will reduce the instability of the wetting front, the increase in hydraulic conductivity ratio increases the instability. This may explain the formation of fingers in initially wet layered soils. The experiments described were conducted on air-dry soils. In soils with higher initial moisture content, the wetting front could remain stable at hydraulic conductivity ratios higher than 20. (Author's abstract)
W89-12637

SULFATE REDUCTION AND OTHER SEDIMENTARY BIOGEOCHEMISTRY IN A NORTHERN NEW ENGLAND SALT MARSH.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
For primary bibliographic entry see Field 2L.
W89-12705

HYDROLYSIS OF METHYL PARATHION IN A FLOODED SOIL.
Central Rice Research Inst., Cuttack (India). Lab. of Soil Microbiology.
For primary bibliographic entry see Field 5B.
W89-12736

DISTRIBUTION OF ATRAZINE, SIMAZINE, ALACHLOR, AND METOLACHLOR IN SOIL PROFILES IN CONNECTICUT.
Connecticut Agricultural Experiment Station, New Haven.
For primary bibliographic entry see Field 5B.
W89-12743

SOME RELATIONSHIPS BETWEEN PLANT GROWTH AND SOIL MOISTURE VARIATIONS.
Kagoshima Univ. (Japan). Lab. of Tropical Crops.
For primary bibliographic entry see Field 2I.
W89-12776

EARLY GROWTH IN SORGHUM PLANT UNDER COMBINED TREATMENTS OF SOIL MOISTURE AND CALCIUM PHOSPHATE APPLICATION.
Kagoshima Univ. (Japan). Lab. of Tropical Crops.
For primary bibliographic entry see Field 2I.
W89-12777

CHANGES IN SOIL WATER REGIME AFTER PIPELINE CONSTRUCTION IN SOLONETZIC MIXED PRAIRIE RANGELAND.
Alberta Univ., Edmonton. Dept. of Plant Science.
For primary bibliographic entry see Field 4C.
W89-12832

HYDRAULIC CONDUCTIVITY MEASUREMENTS IN THE UNSATURATED ZONE USING IMPROVED WELL ANALYSES.
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 7B.
W89-12878

ASYMPTOTIC SOLUTIONS OF THE SEEPAGE EXCLUSION PROBLEM FOR ELLIPTIC-CYLINDRICAL, SPHEROIDAL, AND STRIP-SHAPED AND DISC-SHAPED CAVITIES.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Envi-

ronmental Mechanics.
J. R. Philip.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1531-1540, July 1989. 6 fig, 2 tab, 11 ref, append.

Descriptors: *Seepage, *Mathematical analysis, *Soil water, Hydraulic conductivity, Permeability.

Asymptotic roof boundary layer solutions were obtained for the quasi-linear seepage exclusion problem for elliptic-cylindrical and spheroidal cavities of arbitrary aspect ratio. Previous studies showed the importance of cavity geometry in governing whether or not a particular cavity in a given soil excludes or admits water from a given downward unsaturated seepage field. By studying elliptic-cylindrical and spheroidal cavities, including the cases of strip-shaped and disc-shaped cavities, it is possible to unify the results for a wide range of configurations. The strip and disc solutions give accurate descriptions of the flow and potential distribution near the upstream stagnation point on flat-roofed tunnels and axisymmetric repositories of arbitrary cross-section. (Peters-PTT)
W89-12980

MASS RESPONSE FUNCTIONS.
Trento Univ. (Italy). Dept. of Engineering.
For primary bibliographic entry see Field 5B.
W89-12987

INFLUENCE OF SLOPE ON SUBSURFACE DRAINAGE OF HILLSIDES.
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
G. Fipps, and R. W. Skaggs.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1717-1726, July 1989. 12 fig, 7 tab, 29 ref.

Descriptors: *Drainage, *Subsurface drainage, *Slopes, *Soil water, *Unsaturated flow, *Drains, Infiltration, Water table, Flow characteristics, Mathematical analysis, Flow rates.

Hillside drainage was investigated using numerical solutions to the two-dimensional form of the Richards equation for combined unsaturated flow. The objectives of the study were to examine the influence of slope on drain flow rates and water table depths in the center regions of sloping hillsides. Solutions were obtained for slopes 135 m long, containing parallel drains spaced 30 m apart and located 1 m below the surface in 3-m and 7-m deep profiles. Drainage under steady infiltration and for transient conditions was simulated on slopes of up to 0.40 m/m using two soils. Small slopes (<0.15 m/m) had little effect on drain flow rates and water table depths in the center of the region, indicating that drainage theory developed for flat land can be used for interior parallel drains on these slopes. (Author's abstract)
W89-12997

MODEL FOR HYSTERETIC CONSTITUTIVE RELATIONS GOVERNING MULTIPHASE FLOW 3. REFINEMENTS AND NUMERICAL SIMULATIONS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
R. J. Lenhard, J. C. Parker, and J. J. Kaluarachchi.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1727-1736, July 1989. 11 fig, 2 tab, 15 ref. DOE contract DE-AC06-76RLO; EPA agreement R-814320-01-0.

Descriptors: *Unsaturated flow, *Path of pollutants, *Groundwater movement, *Oily water, *Soil water, *Water table, *Model studies, *Hysteresis, Permeability, Mathematical models, Saturation, Finite element method, Flow.

Refinements are proposed to a constitutive model for hysteretic three-phase permeability saturation-pressure relations. The modifications involve distinguishing between various mechanisms of air entrapment in water and oil phases required to ensure consistency in mass balance calculations. Analytical saturation-pressure derivatives for the three-phase hysteretic permeability-saturation-pressure (k-S-P) model were derived which provide exact representations of fluid pair capacities needed for implicit numerical solution of the governing equations for three-phase flow. The hysteretic constitutive model was incorporated into a finite element multiphase flow code to enable simulation of transient three-phase flow under conditions of arbitrary saturation path history. Simulations were conducted for a scenario involving the injection of an oil slug into a vertical soil profile subjected to a fluctuating groundwater table. In addition to simulations with the full hysteresis model, runs were performed with a model which considers hysteresis due to nonwetting fluid entrapment effects only and to a model which disregards hysteresis entirely. Full hysteresis and trapped fluid only analyses yielded very similar results. The hysteretic models predicted about two thirds of the 7.5 cm of injected oil would become trapped by a 50-cm increase in water table elevation. Ignoring fluid entrapment may lead to large errors in predicted fluid distributions during periods of rising water tables. (Author's abstract)
W89-12998

RELATIONSHIP BETWEEN GREEN AND AMPT PARAMETERS BASED ON SCALING CONCEPTS AND FIELD-MEASURED HYDRAULIC DATA.
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
L. R. Ahuja, D. L. Nofziger, D. Swartzendruber, and J. D. Ross.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1766-1770, July 1989. 3 fig, 1 tab, 21 ref.

Descriptors: *Hydraulic conductivity, *Soil water, *Soil properties, *Infiltration, *Statistical analysis, *Mathematical analysis, Hydraulic properties, Capillarity.

For possible use in resource management models, the relationship aspects of wetting front suction head and near-saturated hydraulic conductivity K, the parameters of the Green and Ampt infiltration equation, were examined. Analysis of nonsimilar-media scaling and a capillary tube bundle implied the power function relationship of negative slope linearity of log wetting front suction head versus log K. Experimentally, the wetting front suction head and Ks were obtained from field-measured hydraulic conductivity versus suction head for five soils. For each soil, of the total variation of log wetting front suction head regressed linearly on log Ks, less than half was due to regression, although the correspondingly small correlation coefficients were highly significant statistically. Hence log wetting front suction head versus log Ks displayed more independence than dependence. Also, based on regression line intercepts, only three soils could be reasonably grouped together. Whether such an indifferent relationship is useful, as in a large ensemble of wetting front suction heads and Ks over spatially variables areas, needs further evaluation. (Author's abstract)
W89-13003

COMPARISON OF TWO METHODS FOR DETERMINING THE EVAPOTRANSPIRATION AND DRAINAGE COMPONENTS OF THE SOIL WATER BALANCE.
Alberta Univ., Edmonton. Dept. of Soil Science.
C. P. Maule, and D. S. Chanasyk.
Canadian Journal of Soil Science CJSSAR, Vol. 67, No. 1, p 43-54, February 1987. 2 fig, 8 tab, 34 ref.

Descriptors: *Soil water, *Evapotranspiration, *Soil-water-plant relationships, *Drainage, Hydrologic budget, Field tests, Moisture content, Seasonal variation, Root zone, Barley, Comparison studies.

Two techniques for separating soil moisture loss into drainage and evapotranspiration for cropped conditions were compared. The study was conducted during May through September 1983 at Ellerslie, Alberta. One technique, the field capacity method, utilized soil tension at -4 kPa to demarcate the cessation of drainage; the other technique, the gradient method utilized changes in soil moisture status relative to fallow conditions, to mark the onset of moisture extraction by roots. Both methods estimated similar amounts of drainage and evapotranspiration for barley plots. Application and thus proper evaluation of these two methods were limited because more than 83% of the total drainage occurred during a 3-week period in which only the Penman method for estimating evapotranspiration could be used. (Author's abstract)
W89-13180

ESTIMATED LONG-TERM SOIL MOISTURE VARIABILITY ON THE CANADIAN PRAIRIES.
Agriculture Canada, Ottawa (Ontario). Land Resource Research Centre.
R. De Jong, and A. Bootsma.
Canadian Journal of Soil Science CJSSAR, Vol. 68, No. 2, p 307-321, May 1988. 7 fig, 5 tab, 27 ref.

Descriptors: *Soil water, *Prairies, *Canada, *Water conservation, *Wheat, *Water stress, Agriculture, Regression analysis, Correlation analysis, Fallowing, Soil-water-plant relationships, Moisture availability, Available water-holding capacity, Seasonal variation.

Soil water contents under wheat production systems on the Canadian prairies were estimated using the Versatile Soil Moisture Budget, which was modified to include an estimated seeding date and a biometeorological time scale. Large year-to-year variability required the use of long term (60 yr) data to describe seasonal and probable occurrences of soil water contents for 27 stations. Regression and correlation analyses were used to simplify presentation of the data and to display their spatial distribution. Summer fallowing was most effective in conserving water in areas with intermediate spring soil water contents and on soils with a higher available water-holding capacity (AWC). In abnormally dry years (i.e., 10% probability) summer fallowing conserved more water in the wetter areas, while increasing the AWCs had the greatest effect on conserved water in the intermediate areas. Soil water contents at heading were greater under wheat-fallow rotation compared to continuous wheat and increased with increasing AWCs. Water contents of less than 50% of AWC at heading occurred with a probability of 80% or higher in most areas, indicating some stress is experienced in most years. Summer fallowing lowered the probability only slightly on soils with a low AWC, but by 10-20% on the higher AWC soils. The probability of extreme water stress at heading (i.e., water contents < or = 10% of AWC) ranged from 0% in the wettest areas to 40-60% in the driest climatic area. (Author's abstract)
W89-13182

EFFECTS OF AGRICULTURAL WATER TABLE MANAGEMENT ON DRAINAGE WATER QUALITY.
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W89-13320

SOIL CHEMISTRY AND PHOSPHORUS RETENTION CAPACITY OF NORTH CAROLINA COASTAL PLAIN SWAMPS RECEIVING SEWAGE EFFLUENT.
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5D.
W89-13353

STABLE-ISOTOPE INVESTIGATION OF VAPOR TRANSPORT DURING GROUNDWATER RECHARGE IN NEW MEXICO.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
F. M. Phillips, R. G. Knowlton, and A. R. Campbell.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-193361/AS. Price codes: A05 in paper copy, A01 in micro-

fiche. New Mexico Water-Resources Research Institute, Las Cruces, Technical Completion Report No. 237, February 1989. 88p, 24 fig, 41 ref, append. Contract 14-08-0001-G1438. State project 1345644; USGS G143806.

Descriptors: *Stable isotopes, *Groundwater recharge, *Water vapor, *New Mexico, *Isotope studies, *Flash distillation, Deuterium, Oxygen isotopes, Tritium, Chlorine, Analytical technique, Hydrogen isotopes.

New Mexico (especially the southern part of the state) is heavily dependent on groundwater for agricultural irrigation, municipal supply, and economic development. The quantification of recharge is thus very important to scientist, engineers, and water resource planners. A technique was presented to model the transport of the stable isotopes H2 and O18. This technique is based upon work by Barnes and Allison (1984). The model developed here can predict the shape of the stable isotope profiles in the vadose zone, and also quantify the vapor flux portion of soil-water movement. Through a non linear least-squares approach, the model is matched to an observed isotope profile by optimizing the values of specified variables. The optimized parameters are then used to solve numerically for the vapor flux as a percentage of the deep flux of water below the root zone. This technique of modeling the isotope species transport is much more robust than conventional heat and moisture flow modeling techniques. This conclusion stems from the fact that the effective isotopic diffusivities vary little with water content, whereas hydraulic diffusivity is strongly dependent on water content. Based upon the model results, in the top 2.7 m of the soil profile a depth-averaged estimate of 15 to 33% of the total soil-water movement is in the vapor phase. This implies that the liquid flux of water is most important in the recharge process. The vapor flux is substantial enough to strongly influence the solute transport characteristics of the system. The strong downward vapor flux is also confirmed qualitatively by the pronounced minimum in the isotope profiles. The lighter isotopes, O16 and H 1, are preferentially transported in the vapor phase and condensed at depth, thereby causing the depletion of the isotope ratios. A vacuum distillation procedure has been developed to extract soil water from soil samples without isotopic fractionation. This new technique is an alternative to the azeotrophic toluene distillation method used by other investigation. (Phillips-NM Inst. Mining and Technology)
W89-13359

CONTRIBUTION OF SUBSOIL AND AQUIFER MICROORGANISMS TO GROUNDWATER QUALITY.
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W89-13406

2H. Lakes

REASONS FOR THE ACCLIMATION FOR 2,4-D BIODEGRADATION IN LAKE WATER.
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W89-12176

DELIVERY OF NONPOINT-SOURCE PHOSPHORUS FROM CULTIVATED MUCKLANDS TO LAKE ONTARIO.
New York State Dept. of Environmental Conservation, Albany. Bureau of Technical Services and Research.
For primary bibliographic entry see Field 5B.
W89-12177

IMPORTANCE OF PHYTOPLANKTON PHOTOADAPTATION IN INFLUENCING ESTIMATES OF INTEGRAL PHOTOSYNTHESIS.
Uppsala Univ. (Sweden). Dept. of Hydrology.
D. C. Pierson.
Nordic Hydrology NOHYBB, Vol. 20, No. 1, p 53-72, 1989. 7 fig, 1 tab, 27 ref.

Descriptors: *Light quality, *Limnology, *Phytoplankton, *Photosynthesis, *Lakes, Mixing, Photoadaptation, Estimating, Limiting, Biomass.

The rates of light limited (alphaB) and light saturated (PmaxB) photosynthesis per unit chlorophyll often showed significant differences between the samples from the top and the bottom of the mixed layer in Lake Erken. The importance of these vertical variations to the photosynthetic rate of the lake as a whole was examined by systematically changing the vertical weighting given to the biomass specific photosynthesis rates associated with each depth, when calculating integral photosynthesis. These simulations, carried out over the 3 month period from July to September of 1987, suggest that vertical variations in rates of biomass specific photosynthesis could account for at most a 24 to 36 percent change in monthly rates of integral photosynthesis. This variance in integral photosynthesis was similar to that which could result from inaccurate estimates of integral biomass, but was less than the measured temporal variability in integral photosynthesis. It was not possible to identify the specific processes responsible for the vertical variations in biomass specific photosynthesis, but evidence does suggest that photoinhibition of the surface phytoplankton was partially responsible, particularly when biomass increased in the presence of blue-green algae. Simulations which increasingly redistributed the total integral biomass to the upper 1-4 m of the water column suggest that while the upward migration of blue-green algae may lead to enhanced levels of photoinhibition, the effect on integral photosynthesis may be partially offset by increased concentrations of biomass at surface light intensities. (Author's abstract)
W89-12198

LAKE TINAROO (AUSTRALIA): TOWARDS A MANAGEMENT PLAN.
Queensland Water Resources Commission, Mareeba (Australia). Far Northern Regional Office.
For primary bibliographic entry see Field 5G.
W89-12216

WATER QUALITY, PHOSPHORUS BUDGETS AND MANAGEMENT OF DUNE LAKES USED FOR RECREATION IN QUEENSLAND (AUSTRALIA).
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.
W89-12218

NEW FORM OF WATER QUALITY INDEX FOR RIVERS AND STREAMS.
Department of Scientific and Industrial Research, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 7C.
W89-12220

IMPACT OF CATCHMENT URBANISATION ON LAKE MACQUARIE (AUSTRALIA).
State Pollution Control Commission, Lidcombe (Australia).
For primary bibliographic entry see Field 4C.
W89-12231

WATER QUALITY MANAGEMENT AT PALM MEADOWS GOLF COURSE (AUSTRALIA) BY LIMITED TIDAL EXCHANGE.
Winders, Barlow and Morrison Pty Ltd., Brisbane (Australia).
For primary bibliographic entry see Field 5G.
W89-12232

SEASONAL DYNAMICS OF BENTHIC DIATOMS ON SOLID SUBSTRATES OF THE SEVASTOPOL BAY (SEZONNAYA DINAMIKA BENTOSN'IKH DIATOMOV'IKH VODOROSLEI NA TVERD'IKH SUBSTRATAKH SEVASTOPOL'SKOI BUKHTY).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
E. L. Nevrova, and N. E. Gusliakov.
Ekologiia Moria, Vol. 30, p 25-28, 1988. 3 tab, 15 ref. English summary.

Descriptors: *USSR, *Benthic environment, *Diatoms, *Sevastopol Bay, *Seasonal variation, Water pollution, Vertical distribution.

The systemic composition, total numbers and biomass of benthic diatoms were studied year round at 0-0.5 m at 2 stations in Sevastopol Bay in the Black Sea. The maximum number and biomass were found in spring at a depth of 0.5 m in this closed bay subject to pollution. (Author's abstract)
W89-12250

PHOSPHATE CONSUMPTION BY DIFFERENT DIMENSIONAL FRACTIONS OF A MICROPLANKTONIC COMMUNITY IN THE MEDITERRANEAN (POTREBLENIE FOSFATOV RAZLICHNYMI RAZMERIYMI FRAKTSIIAMI MIKROPLANKTONNOGO SOOBSHCHESTVA V SREDIZEMNOM MORE).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
A. V. Parkhomenko, and L. V. Georgieva.
Ekologiia Moria, Vol. 30, p 46-50, 1988. 2 tab, 13 ref. English summary.

Descriptors: *Nutrients, *Cycling nutrients, *Phosphates, *Mediterranean Sea, *Phytoplankton, Species composition.

Species composition, phytoplankton numbers, and phytoplankton dimensional structures were investigated in a Mediterranean photic layer. The amount of phosphate consumed by seven different dimensional fractions of microplankton was analyzed. The 0.4-3 microm-size fraction of the microplankton was responsible for the greatest consumption of phosphates (about 80%). (Author's abstract)
W89-12252

CONSUMPTION OF INORGANIC PHOSPHORUS BY DIFFERENT DIMENSIONAL GROUPS OF MICROPLANKTON IN SEVASTOPOL BAY (POGLOSHCHENIE NEORGANICHESKOGO FOSFORA RAZLICHNYMI RAZMERNYMI GRUPPAMI MIKROPLANKTONA V SEVASTOPOL'SKOI BUKHTE).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
For primary bibliographic entry see Field 2L.
W89-12253

ACCUMULATION AND FIXATION OF VARIOUS FORMS OF STABLE AND RADIOACTIVE SULPHUR BY THE BLACK SEA ALGAE (NAKOPLENIE I FIKSATSIIA RAZLICHNYKH FORM STABILVNOI I RADIOAKTIVNOI SERY CHERNOMORSKIMI VODOROSLIAMI) (IN RUSSIAN).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
D. D. Ryndina.
Ekologiia Moria, Vol. 30 p 78-82, 1988. 3 tab, 9 ref. English summary.

Descriptors: *Eutrophic waters, *USSR, *Algae, *Sulfates, *Black Sea, *Bioaccumulation, Fate of pollutants, Macrophytes, Sulfur compounds, Sulfur.

Results of studies are presented that show the distribution of various forms of radioactive and stable sulphur with respect to the biochemical components of sea algae Cystoseira barbata and Enteromorpha intestinalis. It was found that sulphur in the form of sulfate ions accumulated in plant tissues is reduced to 35S(-2). The access of bivalent sulphur 35S(-2) to macrophytes from the environment is extremely difficult. Because the bivalent sulfur is localized in protein substances it loses mobility. The availability of various forms of sulphur (sulpho-conjugate, proteinaceous, inorganic) in the algae show that sulfur compounds have diverse functions in the vital activities of the organism. (Author's abstract)
W89-12254

PRODUCTION OF BACTERIOPLANKTON IN SOME BULGARIAN RESERVOIRS (PRODUKTSIYA BAKTERIOPLANKTONA V NEKOTORYKL VODO KHRANILISHCHAKL BOLGARII) (IN BULGARIAN).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
T. A. Tsankova.
Hydrobiologia HYDRB8, Vol. 27, p 36-40, 1986. 2 tab, 16 ref. English summary.

Descriptors: *Bulgaria, *Bacteria, *Reservoirs, *Limnology, Biomass, Eutrophication, Water pollution effects, Drinking water.

The production of bacterioplankton, the speed of propagation, and bacterial biomass was investigated in the Bulgarian reservoirs of Iskar, Stoudena and Pancarevo for the period 1978-1980. The average 24 hr bacterial production was greater in the contaminated reservoir of Pancarevo (1.75 mg/cu dm moist weight) than in the pure drinking water reservoirs of Iskar and Stoudena (0.54 and 0.25 mg/cu dm moist weight). On the basis of these data for bacterial production, as well as some other indicators, it is concluded that microflora activity is more intense in the more trophic water reservoirs. (Author's abstract)
W89-12257

DYNAMICS OF THE QUANTITATIVE BACTERIOLOGICAL CHARACTERISTICS OF WATER QUALITY IN MESTA RIVER IN CONNECTION WITH ITS SELF-PURIFICATION (DINAMIKA KOLICHESTVENNYKH MIKROBIOLOGICHES KIKH POKAZATELEI KACHESTVA VODY PEKI MESTA VSVIYAZI C EYO SAMOOHISHCLENIEN) (IN BULGARIAN).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 5B.
W89-12258

PRODUCTION OF ORGANIC MATTER IN GEOTHERMAL SOURCES (PRODUTSIROVANIE ORGANICHESKOGO VESHCHESTVA V GEOTERMAL'NYKH ISTOCHNIKAK).
Akademiya Navuk BSSR, Minsk. Inst. of Zoology.
N. N. Khmeleva, and A. P. Ostapeniya.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 23, No. 1, p 8-12, 1987. 1 fig, 2 tab, 11 ref. English summary.

Descriptors: *Geothermal resources, *Primary productivity, *Cyanophyta, *Organic matter, Bacteria, Algae, Trophic level, Temperature gradient.

Ecosystems of geothermal sources are characterized by considerable values of primary production (5-20 g of O2/sq m/day), white the water quality remains high. Blue-green algae are a basic producer of the organic matter. They form (together with bacteria) an algal-bacterial mat on the bottom. The mat is a trophically valuable substance and satisfies food requirements of heterotrophic ecosystem links. A peculiarity of the geothermal water bodies is their division into autotrophic and heterotrophic zones associated with the temperature gradient of the operation of the biological processes. (Author's abstract)
W89-12266

DYNAMIC INFUSARIA FROM WATER RESERVOIRS IN NAKHICHEVANNIAN ASSR (SVOBODNOZHIVUSHCHIE INFUZORII VODOKHRANILISHCHIE NAKHICHEVANSKOI ASSR).
Akademiya Nauk Azerbaidzhanskoi SSR, Baku. Inst. Zoologii.
I. K. Aleksandrov.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 23, No. 1, p 26-31, 1987. 5 fig, 11 ref. English summary.

Descriptors: *Protozoa, *Limnology, *Reservoirs, *Azerbaijan, *Species composition, *Seasonal variation, Aquatic animals, Population dynamics.

Protozoa from four water reservoirs of the Nakhichevanian ASSR (Negramian, Uzunobinian, Nakhichevanian, and Dastagelian) were studied. Sixty-five of the 168 species were observed for the first time in the USSR. Their comparison (by the number of species) with protozoa in other regions of Azerbaijan shows diversity and considerable difference in the species composition of these animals populating water reservoirs of the Nakhichevanian ASSR (K=0.27). The seasonal dynamics of these protozoa is characterized by three peaks: spring, summer and autumn. Vertical distribution of the most typical species of planktonic and benthic protozoa is being analyzed. (Author's abstract)
W89-12267

CHEMICAL COMPOSITION OF WATER AND PLANKTON IN A COOLANT-RESERVOIR (ATOMIC-ENERGY) IN SOUTHERN UKRAINE (KHIMICHESKII SOSTAV VODY I PLANKTON VODOEMA-OKHLADITELIA IUZHNO-UKRAINSKII AES).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5B.
W89-12271

SUBGLACIAL AND GLACIAL COEXISTENCE OF ALGOFLORA (PODLEDNYE I LEDOVYE SOOBSHCHESTVA VODOROSLEI).
Bashkirskii Gosudarstvennyi Univ., Ufa (USSR).
F. B. Shkundina.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 6, p 15-18, 1988. 2 tab, 5 ref. English summary.

Descriptors: *USSR, *Lake Kandry-Kul, *Kama River, *Belaya River, *Algae, *Iced lakes, *Glaciers, Karst lakes, Lake ice, Saline lakes, Cold regions, Species composition, Biomass, Rivers, Pollution index, Phytoplankton.

Species composition, quantity and biomass were investigated for subglacial and glacial algae of the Kandry-Kul (a saltwater karst lake) and the Belays river, the largest left-bank influx of the Kama river. A community diverse in species composition has developed under ice in lake Kandry-Kul. The species composition of phytoplankton in the Belaya river was considerably poorer. Dominant species prevailed in both water bodies in winter. Algae were found in ice of lake Kandry-Kul and the Belaya river. The quantity and biomass of phytoplankton in the subglacial period was low. According to the pollution index the samples characterized alpha-oligosaprobic and beta' beta-mesosaprobic zones in Lake Kandry-Kul, and an alpha-mesosaprobic zone in the Belaya river. (Author's abstract)
W89-12272

EPIPHYTIC ALGAE GROUPINGS IN CANALS, AND THEIR IMPACT ON WATER QUALITY (EPIFITNYE GRUPPIROVKI VODOROSLEI V KANALAKH I IKH ZNACHENIE DLIA FORMIROVANIIA KACHESTVA VODY).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
O. A. Kuz'ko.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 6, p 25-28, 1988. 1 tab, 7 ref. English summary.

Descriptors: *Canals, *Crimea, *Epiphytes, *Algal growth, Aquatic plants, Channels, Water quality, Plant populations, Cattails.

Epiphytic algae groupings which develop on various species of higher aquatic plants (common reed, narrow-leaved cattail, etc.) were studied in the North-Crimean channel, a typical large nonreveted stream watercourse. The species of higher aquatic plant does not exert an essential effect on the composition of the epiphytic algal groupings, but it does play a key role in their quantitative development. It is shown that epiphytic algal groupings, in nonreveted channels with a predominance of common reed communities, do not have a negative effect on the water quality and evoke no biological damage. (Author's abstract)
W89-12274

OVERGROWTH PECULIARITIES IN THE RESERVOIRS OF UKRAINIAN ALLUVIAL PLAINS (DINAMIKA ZARASTANIYA VODOIEMOV UKRAINSKOGO POLEC'YA).
Akademiya Nauk URSR, Kiev. Inst. Botaniki.
T. L. Andrienko.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 2, p 7-13, 1988. 2 fig, 17 ref. English summary.

Descriptors: *Reservoirs, *USSR, *Aquatic plants, *Ukraine, *Vegetation effects, Aquatic weeds, Meadows.

Patterns of overgrowth of the Ukrainian Polessie water bodies were investigated. General tendencies of overgrowth in different groups of the regional water bodies were determined. A leading role was established for the dominant aquatic vegetation species in the northern sections of the Ukrainian SSR. The overgrowth of the water bodies results in the formation of communities of mire and meadow type vegetation which are widely distributed in this region. (Author's abstract)
W89-12279

CONSUMPTION OF BACTERIA BY CERTAIN GROUPS OF ORGANISMS IN A KIEV RESERVOIR (POTREBLENIE PLANKTONNYKH BAKTERII NEKOTORYMI GRUPPAMI ZOOPLANKTONA V KIEVSOM VODOKHRANILISHCHE).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
T. V. Golovko, and G. A. Zhdanova.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 2, p 52-58, 1988. 1 fig, 2 tab, 28 ref. English summary.

Descriptors: *Limnology, *Food chains, *Bacteria, *Copepods, *Rotifers, *Kiev Reservoir, *Reservoirs, Seasonal variation, Plankton, Nutrition.

Studies of the intensity and efficiency of the consumption of bacterial nutritional resources in the Kiev reservoir by the Copepoda and Rotifer zooplankton have shown that planktonic bacteria are able to provide a considerable part of the ration for the consumers studied. Bacteria were of maximum trophic significance in July and in the areas with river conditions. A positive relation between consumption of bacteria and their concentration was observed only with the most typical (for the Kiev reservoir) amount of consumers. (Author's abstract)
W89-12281

METHODOLOGICAL FUNDAMENTALS IN STUDYING SEDIMENTATION IN RESERVOIRS--A SURVEY (METODOLOGICHESKIE OSNOVY IZUCHENIYA SEDIMENTATSII V VODOEMAKH) (OBZOR).
Akademiya Nauk Armyanskoi SSR, Sevan. Hydrobiological Station.
For primary bibliographic entry see Field 2J.
W89-12283

ECHO LOCATION OF CORIXIDS IN DEEP WATER IN AN ACID LOCH.
Institute of Terrestrial Ecology, Edinburgh (Scotland).
For primary bibliographic entry see Field 5C.
W89-12288

EFFECT OF A DEVELOPING ALGAL ASSEMBLAGE ON THE HYDRODYNAMICS NEAR SUBSTRATES OF DIFFERENT SIZES.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2E.
W89-12289

MEXICAN ROTIFERS AS INDICATORS OF WATER QUALITY WITH DESCRIPTION OF COLLETHECA RIVERAI, N.SP.
Universidad Nacional Autonoma de Mexico, Mexico City. Escuela Nacional de Estudios Profesionales Iztacala.

For primary bibliographic entry see Field 5A.
W89-12291

DIEL DRIFT AND VERTICAL STRATIFICATION OF DRIFTING MACROINVERTEBRATES IN A LARGE EUROPEAN RESERVOIR (RYTHME NYCTHEMERAL ET DISTRIBUTION VERTICALE DE LA DERIVE DES MACROINVERTEBRES BENTHIQUES DANS UNE GRANDE RIVIERE EUROPEENNE).
Lyon-1 Univ., Villeurbanne (France). Lab. d'Ecologie des Eaux Douces.
B. Cellot.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 2, p 265-286, April 1989. 5 fig, 1 tab, 74 ref, append. English summary.

Descriptors: *Aquatic drift, *Stratification, *Stream biota, *Macroinvertebrates, *Reservoirs, Diel drift, Vertical distribution, Aquatic insects, Rhone River, France, Diurnal distribution.

Diel drift of macroinvertebrates was examined, in July, at three levels in the water column of a 7th order stream, the Upper Rhone, near Lyon (France). The phenomenon for total organisms (Hydra excepted) was three time greater at night for all depths, chiefly due to aquatic insects. Total drift density was continuously twice as high near the bottom than at the surface level. All the taxa, however, did not exhibit this kind of vertical distribution. There was no apparent pattern in stratification by size, but the larger individuals were found to be prone to drift with more nocturnal periodicity than the smaller ones. (Author's abstract)
W89-12292

GROWTH CHARACTERISTICS OF WATER LETTUCE (PISTIA STRATIOTES L.) IN SOUTH-WEST NIGERIA.
Ibadan Univ. (Nigeria). Dept. of Botany.
B. M. Sharma, and M. K. C. Sridhar.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 2, p 305-312, April 1989. 6 tab, 14 ref.

Descriptors: *Water lettuce, *Aquatic weed control, *Nigeria, *Aquatic weeds, *Floating plants, *Plant growth, *Lakes, *Saline water intrusion, *Water pollution effects, Hydrogen ion concentration, Light, Sodium chloride, Sodium nitrate, Pistia, Water hyacinth.

Growth characteristics of water lettuce (Pistia stratiotes), a predominant aquatic weed in Nigeria, were studied under different environmental conditions. The optimal pH was found to be 6.1. It showed signs of decay when grown under continuous light. Pure sea water and sea water diluted in 4:1 ratio with lake water were found unfavorable for growth. Mildly polluted waters were found favorable. The plants tolerated up to 2000 mg/l sodium chloride and 1.5 mg/l sodium nitrate. The studies on salinity have a special significance in Nigeria. In some areas, there is a constant intrusion of sea water from Atlantic Ocean during certain periods of the year. In those areas, water lettuce is not common. During September 1984, the sea at Lagos received large quantities of water hyacinth possibly from the neighboring countries and till today, it has been causing nuisance in the coastal waters through proliferation. In this context, the salinity tolerance with and without organic matter, of aquatic plants will be useful for the future control measures. (Author's abstract)
W89-12293

ANALYSIS OF THE COMMUNITY STRUCTURE OF PLANKTONIC CILIATED PROTOZOA RELATIVE TO TROPHIC STATE IN FLORIDA LAKES.
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. R. Beaver, and T. L. Crisman.
Hydrobiologia HYDRB8, Vol. 174, No. 3, p 177-184, April 22, 1989. 3 fig, 3 tab, 22 ref.

Descriptors: *Zooplankton, *Trophic level, *Lakes, *Limnology, *Protozoa, Species composition, Florida, Oligotrophic lakes, Eutrophic lakes, Eutrophication, Acidic water, Productivity, Subtropic zone, Biomass, Species diversity.

The planktonic ciliate populations of 30 Florida lakes constituting a broad trophic gradient were examined to determine the response of protozoan community structure to increasing eutrophication. Both ciliate abundance and biomass were strongly related to lake trophic state. Comparison of the Florida data base with a comparable north temperate lake group indicated that subtropical lakes generally possess higher ciliate abundance and biomass at a given trophic state than temperate lakes. However, the equations derived for each data base were not significantly different. Community diversity and species richness increased with increasing lake productivity. Highly acidic lakes displayed significantly reduced diversity and numbers of species when contrasted with nonacidic oligotrophic lakes. Presence-absence data produced three assemblages: an ubiquitous association of primarily small ciliate taxa, a group of large ciliates mainly restricted to eutrophic-hypereutrophic lakes, and very large ciliate, Stentor niger, which dominated the protozoan communities of acidic oligotrophic lakes. (Author's abstract)
W89-12302

INFLUENCES OF A COLLECTOR-FILTERER CADDISFLY (TRICHOPTERA: HYDROPSYCHE BETTENI ROSS) ON LEAF PROCESSING RATES IN AN ARTIFICIAL STREAM.
Nebraska Univ.-Lincoln. Dept. of Biometrics and Information Systems.
P. O. Darrow, and R. S. Holland.
Hydrobiologia HYDRB8, Vol. 174, No. 3, p 201-205, April 22, 1989. 1 fig, 3 tab, 13 ref.

Descriptors: *Food habits, *Stream biota, *Artificial streams, *Leaf processing, *Aquatic insects, *Caddisflies, *Cottonwood trees, *Particulate matter, Hydropsyche, Leaves, Experimental design.

A 2 x 6 unbalanced fixed effects factorial treatment design was used to examine the effects of a collector-filterer on leaf processing rates of American cottonwood (Populus deltoides) in an artificial stream over a 6-wk period. Pre-leached leaves were placed into 30 small enclosures; collector-filterer caddisflies (Hydropsyche betteni) were added to 18 enclosures resulting in two treatment factors (leaves with and without caddisflies). Changes in leaf dry-weight and caddisfly biomass were determined at weekly sampling intervals. Leaf processing rates were significantly different between treatments over time, with enclosures without caddisflies exhibiting a greater weight loss (higher k value) than enclosures with caddisflies ($p<0.01$). The reduction in processing rates of the leaves due to the presence of caddisflies was attributed to the construction of retreats by these collector-filterers. Under the influence of the caddisfly, leaf material may be able to remain as a viable food resource for a longer period in the stream. (Author's abstract)
W89-12304

EXTRACELLULAR ENZYMATIC ACTIVITY OF AQUATIC AND AERO-AQUATIC CONIDIAL FUNGI.
Basrah Univ. (Iraq). Dept. of Biology.
S. K. Abdullah, and J. Taj-Aldeen.
Hydrobiologia HYDRB8, Vol. 174, No. 3, p 217-223, April 22, 1989. 2 tab, 34 ref.

Descriptors: *Biodegradation, *Aquatic fungi, *Enzymes, *Decomposing organic matter, Cellulase, Amylase, Lipase, Protease, Phenol oxidase, Cellulose, Starch, Lipids, Proteins, Tannic acid.

Nineteen species of aquatic and aero-aquatic conidial fungi were tested for their ability to produce extracellular enzymes which degrade cellulose, starch, lipids, proteins and tannic acid. The cellulolytic activity was determined by using both solid and liquid media. The activity of other enzymes was examined using solid media. Two-thirds of the species were able to hydrolyze soluble cellulose incorporated in solid and liquid media with varying degrees of activity. Extracellular culture filtrates of Aegerita candida, Helicodendron giganteum and H. tubulosum contained a Cl-Cx enzyme complex that could degrade both soluble cellulose and crystalline cellulose (filter paper). Lipase activity was demonstrated by 11 species. Fourteen of the species showed activity for amylase and protease, but only 11 of the 16 were capable of degrading tannic acid. (Author's abstract)
W89-12305

MODEL FOR THE ESTIMATION OF CONVECTIVE EXCHANGE IN THE LITTORAL REGION OF A SHALLOW LAKE DURING COOLING.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
H. G. Stefan, G. M. Horsch, and J. W. Barko.
Hydrobiologia HYDRB8, Vol. 174, No. 3, p 225-234, April 22, 1989. 4 fig, 1 tab, 14 ref, 2 append.

Descriptors: *Model studies, *Water circulation, *Near shore processes, *Lakes, *Littoral zone, *Cooling, *Convection, Nutrient transport, Water temperature, Estimating, Water quality.

Cooling of lakes through the water surface produces horizontal convective exchange flow between the littoral and the open waters. A mixed-cells-in-series model is developed which, using as input the evolution in time of vertical temperature profiles measured along the littoral slope, provides an estimate of the horizontal exchange flow rates. Application of the model to field data shows that the exchange flow can cause rapid renewal of the littoral waters. Thermally induced water exchange between littoral and pelagic regions transports dissolved constituents, e.g. nutrients, thereby affecting water quality in lacustrine systems. (Author's abstract)
W89-12306

UPPER MISSISSIPPI RIVER: SEASONAL AND FLOODPLAIN FOREST INFLUENCES ON ORGANIC MATTER TRANSPORT.
Illinois Natural History Survey, Havana. River Research Lab.
J. W. Grubaugh, and R. V. Anderson.
Hydrobiologia HYDRB8, Vol. 174, No. 3, p 235-244, April 22, 1989. 5 fig, 38 ref. NSF grant BSR-8114563.

Descriptors: *Mississippi River, *Flood plains, *Forests, *Vegetation effects, *Organic matter transport, *Riparian vegetation, *Particulate matter, *Organic compounds, Flood plain forests, Seasonal variation, Flood peak, Phytoplankton, Leaves, Low flow.

Seasonal influences and the role of floodplain forest as source or sink of organic matter is relatively unknown for large, temperate rivers. Discharge and fine-particulate (FPOC), dissolved (DOC), and total organic carbon concentrations (TOC) were measured during five sampling periods from November 1984 to August 1985, above and below the floodplain-forested area (1054 ha) of Burlington Island on navigation Pool 19, upper Mississippi River. Sampling coincided with autumnal leaf fall of the floodplain forest, peak flood and falling spring flood, and low-flow conditions prior to and during phytoplankton bloom. Greatest TOC transport occurred during peak flood (8.84 million Kg/day) and leaf fall (7.79 million Kg/day). Peak flood transport was dominated by FPOC associated with flushing of material from upland areas. Transport during autumnal leaf fall was predominantly DOC attributed to litter leaching. Seasonal DOC loads generally increased downstream except during the phytoplankton bloom when a decrease was associated with increased microbial metabolic activity. Downstream decline in FPOC and decreasing DOC loads during flood peak characterized the mechanism of deposition and processing of FPOC on the floodplain. FPOC concentration was significantly correlated to discharge and DOC concentrations were higher than FPOC except for flood peak. Significant downstream changes in TOC load suggests the importance of riparian vegetation as an influence on organic matter transport in large rivers. (Author's abstract)
W89-12307

RELATIONSHIP BETWEEN PHOTOSYNTHETIC AND RESPIRATORY CARBON METABOLISM IN FRESHWATER PHYTOPLANKTON.
Oklahoma Univ., Norman. Dept. of Zoology.
A. W. Groeger, and B. L. Kimmel.
Hydrobiologia HYDRB8, Vol. 173, No. 2, p 107-117, March 22, 1989. 7 fig, 2 tab, 18 ref. TVA Interagency Agreement No. 40-1165-81, Environmental Laboratory of the US Army Waterways Experiment Station Interagency Agreement No. 40-1199-81, Ecological Research Division, Office of Health and Environmental Research, DOE Contract No. DE-AC05-840R21400.

Descriptors: *Phytoplankton, *Algae, *Photosynthesis, *Respiration, *Carbohydrates, Polysaccharides, Lipids, Proteins.

Measurements of algal carbon metabolism in the light and the dark were conducted in (1) short-term (3-h) light and dark incubations, (2) a diel (24-h) experiment, and (3) a longer term (4-d) carbon accumulation experiment to examine the relationship between photosynthetic rates, photosynthetic carbon metabolism in the light, and respiration and carbon metabolism in the ensuing dark period in natural assemblages of freshwater phytoplankton. High rates of photosynthesis and polysaccharide synthesis in the light were followed by high rates of respiration and polysaccharide utilization in the dark. Polysaccharide was the major respiratory substrate in the dark, and small molecular weight metabolites, lipids, and protein were less important sources of metabolic energy. The protein pool accumulated carbon during dark incubations, but more slowly during active photosynthesis in the light. Because the intracellular macromolecular pools turn over at very different rates (polysaccharide > protein and lipid), patterns of short-term photosynthetic carbon metabolism are not necessarily indicative of the biochemical composition of the phytoplankton. (Author's abstract)
W89-12311

PROTEIN SYNTHESIS: A MEASURE OF GROWTH FOR LAKE PLANKTON.
National Water Research Inst., Burlington (Ontario).
D. R. S. Lean, R. L. Cuhel, and M. N. Charlton.
Hydrobiologia HYDRB8, Vol. 173, No. 2, p 119-126, March 22, 1989. 6 fig, 2 tab, 30 ref.

Descriptors: *Limnology, *Phytoplankton, *Primary productivity, *Proteins, *Phosphorus, *Cycling nutrients, Carbon radioisotopes, Sedimentation, Stratification, Zooplankton grazing, Particulate matter, Organic carbon, Epilimnion, Lake Ontario, Diurnal variation.

Problems in the interpretation of C14-primary production estimates have resulted from the belief that all carbon compounds are created equal and few attempts have been made to include nighttime C14-losses. The energetic costs of protein synthesis are high and once formed protein is not simply used as another form of energy but is conserved along food chains. A portion of the carbohydrate fraction is used to drive night protein synthesis and some, the so-called colloidal dissolved organic carbon which represents a portion of the 'extracellular production', simple aggregates and settles out. Areal productivity measured over 24 h was monitored in Lake Ontario and compared with losses through sedimentation and zooplankton grazing. The balance was related to NET changes in particulate organic carbon concentration. Prior to stratification, sedimentation accounted for most of the carbon losses from the trophogenic zone but during stratification, zooplankton grazing was coupled with plankton growth (determined as protein synthesis per unit particulate protein). This observation, supported by very low phosphorus sedimentation rates, suggests the phosphorus is effectively recycled within the epilimnion. (Author's abstract)
W89-12312

CONTRIBUTION OF PHYTOPLANKTON PRODUCTIVITY IN TURBID FRESHWATERS TO THEIR TROPHIC STATUS.
Orange Free State Univ., Bloemfontein (South Africa). Unit for Limnology.
J. U. Grobbelaar.
Hydrobiologia HYDRB8, Vol. 173, No. 2, p 127-133, March 22, 1989. 4 fig, 1 tab, 21 ref.

Descriptors: *Light quality, *Limnology, *Phytoplankton, *Primary productivity, *Turbidity, Photosynthesis.

Certain factors influencing phytoplankton productivity are accentuated in turbid waters. They include mixing, spectral quality shifts, scattering, light fluctuations, and overall light attenuation. Measurements of productivity are influenced by the presence of inorganic turbidity. Together with the above factors high turbidity causes difficulties in assessing and modelling phytoplankton productivity. Estimations of the slope of light limited photosynthesis vs light intensity, the maximum chlorophyll-specific photosynthetic rate, the light intensity at onset of light saturation, and the maximum quantum yield at limiting light intensities only reflect on the physiological condition of the phytoplankton, which differs little between water types of temperate regions. Measurement of integral vertical productivity, efficiency and fractional absorption by the phytoplankton of light energy conversion, however, are greatly influenced by the inorganic turbidity. Because of high ratios of mixing to euphotic depth, the 'critical mixing' depth is one of the most important factors influencing overall productivity in turbid waters. (Author's abstract)
W89-12313

DISTINCTION BETWEEN LIGHT-MEDIATED AND LIGHT-INDEPENDENT VARIATIONS IN PHYTOPLANKTON PRODUCTION RATES.
Konstanz Univ. (Germany, F.R.). Limnological Inst.
M. M. Tilzer.
Hydrobiologia HYDRB8, Vol. 173, No. 2, p 135-140, March 22, 1989. 4 fig, 28 ref. Deutsche Forschungsgemeinschaft Grant No. Ti 115110.

Descriptors: *Phytoplankton, *Primary productivity, *Photosynthesis, *Limnology, *Light quality, Seasonal variation, Temperature, Chlorophyll, Lake Constance, West Germany.

An array of factors simultaneously controls phytoplankton photosynthesis and hence the primary production process. Because their relative importance shifts both with depth and with season, the significance of individual factors cannot be resolved by in situ incubations, even if all relevant environmental and biotic variables are measured. A procedure is described by which, in addition to in situ measurements, photosynthesis is simultaneously assessed in identical subsamples under constant temperature (10 C) and light (0.66 mol/sq m/h photosynthetically active irradiance conditions, 'in vitro'). By calculating photosynthesis per unit of chlorophyll, effects of shifting biomass on photosynthesis can be eliminated but seasonal variations of light-saturated photosynthesis generated by temperature, and vertical changes of light-requirements (e.g. by light-shade adaptation) remain obscure. Quotients of in situ photosynthetic rates divided by in vitro rates allow the quantification of light-mediated changes. Provided that photosynthesis measured in vitro is light-saturated, quotients of in situ:in vitro rates should never exceed unity. They are a measure of the degree of light-limitation. In vitro rates normalized to chlorophyll give information on temporal changes caused by variations in photosynthetic capacity. In Lake Constance, mean cell size appear to control light-saturated assimilation numbers. (Author's abstract)
W89-12314

BACTERIAL METABOLISM OF ALGAL EXTRACELLULAR CARBON.
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
M. F. Coveney, and R. G. Wetzel.
Hydrobiologia HYDRB8, Vol. 173, No. 2, p 141-149, March 22, 1989. 3 fig, 1 tab, 41 ref. NSF Grant No. (BSR-8307716), DOE Grant No. (DE-ACO276EVO1599, COO-1599-304), Swedish Natural Science Research Council Grant No. (B-PH-3603-102).

Descriptors: *Aquatic bacteria, *Respiration, *Phytoplankton, *Algae, *Organic carbon, Mineralization, Food chains, Carbon radioisotopes, Metabolism.

Measurements of microbial utilization of extracellular organic carbon (EOC) released by phytoplankton commonly consider only EOC fractions subject to rapid uptake. Questions remain whether other EOC fractions are metabolized, what portion is labile, and with what assimilation efficiency this carbon substrate is utilized. C14-EOC was prepared by incubation of the natural mixed planktonic community from an oligotrophic lake with C14-HCO3 in the light. C14-EOC which was not rapidly removed by heterotrophs remained in solution and was isolated by filtration. This residual EOC was inoculated with lake microheterotrophs in laboratory microcosms, and utilization kinetics were determined through long-term assays of cumulative C14-CO2 production. Time courses for C4-CO2 production were consistent for all assays and were well described by a deterministic mixed-order degradation model. On twelve sampling occasions from 29-76% of residual C14-EOC was labile to further metabolism by lake heterotrophs. First-order rate constants for EOC utilization showed a mode of 0.05 to 0.15 per day. From 33-78% of gross C14-EOC uptake was respired (mean 50%), indicating appreciable return of algal EOC to the pelagic food web as microbial biomass. (Author's abstract)
W89-12315

ALGAL PICOPLANKTON PRODUCTION AND CONTRIBUTION TO FOOD-WEBS IN OLIGOTROPHIC BRITISH COLUMBIA LAKES.
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
J. G. Stockner, and K. S. Shortreed.
Hydrobiologia HYDRB8, Vol. 173, No. 2, p 151-166, March 22, 1989. 6 fig, 2 tab, 40 ref.

Descriptors: *Oligotrophic lakes, *Phytoplankton, *Algae, *Zooplankton, *Limnology, *Food chains, *Salmon, *Fish food organisms, Rotifers, Daphnia, Quesnel Lake, Sproat Lake, British Columbia.

The pelagic communities of two contrasting oligotrophic lakes in British Columbia were studied to determine why an interior, dimictic lake (Quesnel) supports a greater biomass of zooplankton and produces larger planktivorous sockeye salmon (Onchorhynchus nerka) than a coastal warm-monomictic lake (Sproat). The ultra-oligotrophic status and differing planktivore densities in Sproat Lake increased the relative importance of algal picoplankton, diminished the abundance of large zooplankton, and increased the significance of rotifers and other small-bodied zooplankton. These picoplankton based food webs result in longer, indirect and less efficient pathways of carbon flow from phytoplankton to fish. In contrast, Quesnel Lake is a more productive oligotrophic lake and its pelagic food webs are based more on nanoplankton and small microphytoplankton that support larger-bodied zooplankton (Daphnia, Diaptomus), and a more direct and efficient two-step transfer to fish. The greater variability of the annual recruitment of sockeye fry in interior lakes may keep zooplankton communities in a non-steady state; this in turn may perpetuate the occurrence of quadrennial cyclic dominance in adult salmon returning to these systems. (Author's abstract)
W89-12316

PRIMARY PRODUCTION OF PHYTOPLANKTON AND STANDING CROPS OF ZOOPLANKTON AND ZOOBENTHOS IN HYPERTROPHIC LAKE TEGANUMA.
National Inst. for Environmental Studies, Ibaraki (Japan). Environmental Biology Div.
K. Takamura, Y. Sugaya, N. Takamura, T. Hanazato, and M. Yasuno.
Hydrobiologia HYDRB8, Vol. 173, No. 3, p 173-184, March 29, 1989. 7 fig, 3 tab, 56 ref.

Descriptors: *Limnology, *Japan, *Eutrophic lakes, *Phytoplankton, *Primary productivity, *Zooplankton, *Standing crops, Chlorophyll a, Rotifers, Oligochaetes, Midges, Seasonal variation, Lake Teganuma, Japan.

Primary production of phytoplankton and standing crops of zooplankton and zoobenthos were intensively surveyed in Lake Teganuma, Japan during May 1983-April 1984. The annual mean chlorophyll a concentrations were as high as 304-383 microgram/L. The daily gross primary production of phytoplankton was high throughout the year. The peak production rate was recorded in August and September, when blue-green algae bloomed. The annual gross primary production was estimated as 1450 g C/sq m/y, extremely high as compared with other temperate eutrophic lakes. Zooplankton was predominantly composed of rotifers. The annual mean standing crop of zooplankton was 0.182 g C/sq m around the middle between the inlets and the outlet and was lower than in most other temperate eutrophic lakes. Zoobenthos was mostly composed of Oligochaeta and chironomids. The annual mean standing crop of zoobenthos ranged from 0.052-0.265 g C/sq m, the lowest values among temperate eutrophic lakes, which is in contrast to the high primary production. (Author's abstract)
W89-12317

COLONIZATION OF NATURAL SUBSTRATA OF DIFFERENT ROUGHNESS AND COLOUR BY EPHEMEROPTERA NYMPHS USING RETRIEVAL AND DIRECT OBSERVATION TECHNIQUES.
Alberta Univ., Edmonton. Dept. of Zoology.
R. J. Casey, and H. F. Clifford.
Hydrobiologia HYDRB8, Vol. 173, No. 3, p 185-192, March 29, 1989. 2 tab, 28 ref.

Descriptors: *Aquatic insects, *Colonization, Animal behavior, Mayflies, Streams, Lotic environment.

The colonization of stream substrata by Ephemeroptera in a Canadian Rocky Mountain stream was investigated. Stream substrata used were different textures (smooth and rough) and colors (dark and light); the taxonomic groups studied were Drunella coloradensis (Ephemerellidae), Heptageniidae (Cinygmula and Epeorus) and a Baetis-Ameletus group (Baetidae and Siphlonuridae). The hypothesis was tested that as D. coloradensis nymphs and other abundant Ephemeroptera nymphs increase in size they choose a dark substratum to remain cryptic and a substratum of greater texture to reduce the risk of being swept from the substratum by the water flow. Two approaches were used to test this hypothesis, a substratum basket experiment and direct observations. For the substratum basket experiment, there were no statistical differences in abundances of nymphs on the substratum types, but there was a general tendency that the D. coloradensis nymphs were least abundant on the rough dark-colored substratum and developmental stage three nymphs were most abundant on the smooth white-colored substratum. Colonization was investigated for other Ephemeroptera nymphs by making direct observations on the substratum baskets using a glass-bottomed box. For the taxonomic groups and two colonization periods, nymphs were statistically at greatest density on the smooth white-colored substratum and lowest on the smooth black-colored substratum. The Baetis-Ameletus groups were also found at greatest densities on the rough dark-colored substratum. (Author's abstract)
W89-12318

FIELD EVALUATION OF A MICRO-EXTRACTION TECHNIQUE FOR MEASURING CHLOROPHYLL IN LAKEWATER WITHOUT FILTRATION.
Wisconsin Univ.-Madison. Center for Limnology.
For primary bibliographic entry see Field 7B.
W89-12319

PLANT COMMUNITY DYNAMICS IN A CHAIN OF LAKES: PRINCIPAL FACTORS IN THE DECLINE OF ROOTED MACROPHYTES WITH EUTROPHICATION.
Wayne State Univ., Detroit, MI. Dept. of Biological Sciences.
R. A. Hough, M. D. Fornwall, B. J. Negele, R. L. Thompson, and D. A. Putt.
Hydrobiologia HYDRB8, Vol. 173, No. 3, p 199-217, March 29, 1989. 11 fig, 10 tab, 52 ref. NSF Grants DEB 7604503 and DEB 81-D3528.

Descriptors: *Limnology, *Rooted aquatic plants, *Lakes, *Eutrophication, *Population dynamics, *Phytoplankton, *Nutrient concentrations, *Species diversity, Porductivity, Periphyton, Light, Shoe Lake, East Graham Lake, Lake Michigan.

Shoe Lake and East Graham Lake, part of a small chain of lakes in southeastern Michigan, differ in nutrient loading and in the structure and productivity of their aquatic plant communities. A comparative study of species frequency and biomass distributions, nutrient contents, and responses to experimental nutrient enrichment and shading, was conducted to determine the principal factors controlling the macrophyte dynamics. A central objective was to address the question of why rooted macrophyte growth declines with eutrophication, and to test existing models designed to explain this phenomenon. In the more eutrophic Shoe Lake, diversity and productivity of rooted macrophytes were relatively low, restricted primarily by combined shading of phytoplankton, periphyton, and non-rooted macrophytes (principally Ceratophyllum demersum, along with Utricularia vulgaris and Cladophora fracta). In the less eutrophic East Graham Lake, lower nitrogen availability restricted the growth of all of these shading components, resulting in clearer water and higher productivity and diversity of rooted macrophytes. The macrophytes did not allelopathically suppress the phytoplankton in East Graham Lake. The results supported a direct relationship between nutrient loading, increasing growth of phytoplankton, periphyton and non-rooted macrophytes, and decline of rooted macrophytes. (Author's abstract)
W89-12320

SEASONAL PERIODICITY OF AQUATIC FUNGI IN TANKS AT KURUKSHETRA, INDIA.
Kurukshetra Univ. (India). Dept. of Botany.
A. K. Gupta, and R. S. Mehrotra.
Hydrobiologia HYDRB8, Vol. 173, No. 3, p 219-229, March 29, 1989. 4 fig, 2 tab, 31 ref.

Descriptors: *Aquatic fungi, *Water tanks, *Seasonal variation, *Temperature effects, Species distribution, India.

The occurrence, distribution and seasonal periodicity of aquatic fungi from two different water tanks of Kurukshetra, India, were studied. The 49 species collected during this study belonging to the orders Chytridiales, Lagenidiales, Blastocladiales, Saprolegniales and Peronosporales, were grouped into low temperature species, low to moderate temperature species, moderate to high temperature species and constant species according to their temperature requirements. The occurrence of aquatic fungi was found to be inversely correlated with temperature. A distinct seasonal variation in occurrence of aquatic fungi was noted and although the individual periodicity pattern varies, most of the species were frequent in the low and moderate temperature range. Periodicity pattern is governed by temperature. Maximum occurrence of aquatic fungi was obtained in the winter season. (Author's abstract)
W89-12321

FORMATION OF PHENOL-PROTEIN COMPLEXES AND THEIR USE BY TWO STREAM INVERTEBRATES.
Mount Allison Univ., Sackville (New Brunswick). Dept. of Biology.
F. Barlocher, P. G. Tibbo, and S. H. Christie.
Hydrobiologia HYDRB8, Vol. 173, No. 3, p 243-249, March 29, 1989. 6 tab, 21 ref.

Descriptors: *Cycling nutrients, *Detritus, *Proteins, *Surfactants, *Enzymes, *Aquatic insects, Maple leaves, Pine needles, Amino acids, Sugars, Phenolics, Amphipods, Craneflies, Gammarus, Tipula, Substrates.

Ethanol and water extracts of maple leaves and pine needles were analyzed for proteins, amino acids, sugars and phenolics. Leachates were mixed with a dissolved fungal cellulase. Within 24 h, insoluble particles formed, consisting of phenolics, proteins, and amino acids. When exposed to an alkaline pH, or to a 0.04% solution of the surfactant lysolecithin, these particles released amino acids and proteins. Surface tensions of the gut fluids of Gammarus tigrinus and Tipula caloptera were considerably lower than that of distilled water, suggesting the presence of surfactants. Gut fluid of T. caloptera contained enzymes capable of digesting the proteins of particles formed with maple water extracts. The other particles did not appear susceptible to these enzymes. There was no evidence that G. tigrinus was able to digest the proteins of any of the particles examined. (Author's abstract)
W89-12322

VERTICAL ATTENUATION COEFFICIENT OF DOWNWARD IRRADIANCE IN LAKE OZE.
Gunma Univ., Maebashi (Japan). Faculty of Education.
A. Sugawa.
Japanese Journal of Limnology RIZAAU, Vol. 50, No. 1, p 1-7, 1989. 4 fig, 3 tab, 13 ref.

Descriptors: *Solar radiation, *Light quality, *Optical properties, *Lakes, Lake Oze, Japan.

In Lake Oze, the downward irradiance Ed in the region 400-700 nm was measured in 1987. Ed was measured at depths z=0, 0.1, 0.3, 0.5, 1 m, and then at 1 m intervals to 8 m. Ed at z=0 m was measured just below the lake surface. When the ratio of Ed to Edo, which is the value of Ed at z=0 m, is plotted with a logarithmic scale, the relation between Ed/Edo and z was approximately linear. The vertical attenuation coefficient of downward irradiance Kd ranged from 0.49-0.85/m. In Lake Oze, the absorption coefficient of the lake water was minimum at wavelength 570 or 580 nm, so Ed was estimated to be maximum at 570 or 580 nm, and the incident direct solar radiation at 570 or 580 nm must reach a considerable depth. If it is assumed that the incident direct solar irradiance is mainly attenuated by absorption or the lake water, Kd depends on solar altitude and absorption coefficient. When the values of the angle of refraction and absorption coefficient at 570 nm are given, Kd for downward irradiance at 570 nm is calculated. The calculated values of Kd were in approximate agreement with those obtained from the measurement of Ed except in September. (Author's abstract)
W89-12323

DETERMINATION OF DENITRIFICATION ACTIVITY IN BOTTOM SEDIMENT OF LAKE TEGANUMA AND ITS ROLE IN SELFPURIFICATION OF THE LAKE.
Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Environmental Science and Conservation.
S. Ueda, and N. Ogura.
Japanese Journal of Limnology RIZAAU, Vol. 50, No. 1, p 15-24, 1989. 9 fig, 3 tab, 27 ref. English summary.

Descriptors: *Fate of pollutants, *Lake sediments, *Bottom sediments, *Denitrification, *Self-purification, Nitrates, Nitrites, Water temperature, Water hyacinth, Phytoplankton, Lake Teganuma, Japan.

Denitrification activity in sediment was determined at Lake Teganuma by batch and continuous culture, based on acetylene inhibition technique, during one year from November 1986 at every other month. The activity of denitrification was expressed as a function of water temperature and electron acceptor concentration in overlying water. When the concentration of electron acceptor (nitrate plus nitrite) were sufficient, the activity was estimated to be 30 mg N/sq m/d under annual

mean water temperature. This was equivalent to nearly 8% of total nitrogen input. Removal of nitrogen by denitrification was 2-4% in the winter season (5-10 C) and 12-15% in the summer season (25-30 C) of the total input, respectively. On the other hand, the proportion of nitrogen removal from water by harvesting of water hyacinth and phytoplankton carried out at Lake Teganuma during the summer was estimated to be 0.3% of total nitrogen input and 4% of denitrified nitrogen. Therefore denitrification in sediment is considered to be an important process for nitrogen removal from Lake Teganuma. (Author's abstract)
W89-12324

DYNAMICS OF ZOOPLANKTON COMMUNITY IN ENCLOSURES OF DIFFERENT TYPES IN A SHALLOW EUTROPHIC LAKE.
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
T. Hanazato, H. Hayashi, T. Ichikawa, and Y. Watanabe.
Japanese Journal of Limnology RIZAAU, Vol. 50, No. 1, p 25-37, 1989. 9 fig, 20 ref. Japan Ministry of Education, Science and Culture, Grant in Aid for Special Project Research No. 62124040.

Descriptors: *Field tests, *Species composition, *Limnology, *Eutrophic lakes, *Zooplankton, *Population dynamics, Enclosures, Lake Suwa, Japan.

Changes in abundance and species composition of the zooplankton community in enclosures of different types in Lake Suwa were investigated and compared. Zooplankton abundance was consistently higher in tube type enclosures (5m x 5m x 4.2m), which were open to the bottom sediment, than in bag type enclosures (5m x 5m x 3m), which had bottom sheets. In the latter enclosures, zooplankton abundance gradually decreased during the experimental period. Zooplankton community structure in the tube type enclosure changed in a similar way to that in open lake water for eight months. Therefore, an enclosure of this type was considered to be suitable for maintaining the lake ecosystem over a long period. The phenomenon of a decrease in zooplankton abundance in the bag type enclosure did not apply to the small bag enclosure (1m x 1m x 1m), in which zooplankton had high productivity and a littoral species, Chydorus sphaericus, predominated. This species was not found in the central zone of the large enclosures (in both the bag and tube types). The dominance of C. sphaericus in the small bag enclosure was probably due to wall effects. (Author's abstract)
W89-12325

EVALUATION OF THE DEGREE OF CITRULLINE INTERFERENCE IN THE SPECTROPHOTOMETRY OF UREA WITH DIACETYL MONOXIME IN NATURAL WATERS.
Yamagata Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W89-12326

INORGANIC CARBON AND AMMONIUM UPTAKE BY PHYTOPLANKTON IN NITROGEN DEPLETED WATERS IN LAKE SUWA.
Nagoya Univ. (Japan). Water Research Inst.
M. Sakamoto.
Japanese Journal of Limnology RIZAAU, Vol. 50, No. 1, p 45-51, 1989. 1 fig, 1 tab, 23 ref. Japan Ministry of Education, Science and Culture, Grant in Aid for Special Project Research No. 60129034.

Descriptors: *Limnology, *Cycling nutrients, *Eutrophic lakes, *Japan, *Phytoplankton, Ammonium, Bottom sediments, Lake Suwa, Bicarbonates.

Inorganic carbon and NH4(+) uptake by phytoplankton was studied during a period of nitrogen depletion in early fall of 1985 in Lake Suwa to investigate a possible effect of NH4(+) supply from the bottom sediments on phytoplankton production. Phytoplankton samples from the experimental enclosures were, after being size-fractionated using 40 micron netting, incubated with the simultaneous addition of C13-HCO3(-) at tracer level (6.5-15.6% in excess of ambient dissolved inorganic carbon) and N15-NH4(+) in substrate saturated concentration (54-1330% in excess of ambient NH4(+)) under saturation light intensity for 3-4 h. The <40 micron fraction, consisting of small-sized green algae, monads and diatoms, showed considerably higher specific nitrogen uptake rates than the >40 micron fraction, exclusively composed of large colonial blue-green algae Microcystis spp. There was little difference in specific carbon uptake rates and no difference in photosynthetic activity between the two size fractions. It was suggested that during a period of nitrogen depletion in Lake Suwa a larger supply of NH4(+) from the bottom sediments could more favorably affect the small-sized phytoplankton than the large colonial Microcystis. (Author's abstract)
W89-12327

INTERRELATIONS BETWEEN BLUE-GREEN ALGAE AND ZOOPLANKTON IN EUTROPHIC LAKES: A REVIEW.
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
T. Hanazato.
Japanese Journal of Limnology RIZAAU, Vol. 50, No. 1, p 53-67, 1989. 1 fig, 1 tab, 114 ref. English summary.

Descriptors: *Zooplankton, *Algal toxins, *Limnology, *Eutrophic lakes, *Cyanophyta, Phytoplankton, Toxicity, Reviews, Cladocerans, Copepods, Rotifers, Aquatic bacteria, Nutrients, Food chains, Organic matter.

Studies on interrelations between blue-green algae and zooplankton are reviewed, and the interrelations in eutrophic lakes are discussed. Laboratory experiments have shown that several blue-green algae are toxic to zooplankton and reduce the feeding, assimilation, survival and growth rates of various zooplankters. The algal toxicity differs among algal species and among algal strains. Blue-green algae are considered to be nutritionally inadequate to zooplankton, even if they are non-toxic. In nature, however, the deleterious effects of blue-green algae are recognized only on large-bodied cladocerans. In lakes where blue-green algae are blooming, the zooplankton community is usually dominated by small-bodied cladocerans, rotifers and copepods. They seem to have different mechanisms to coexist with the algal blooms, i.e., inability to consume filamentous or large colonial blue-green algae (small-bodied cladocerans), resistance to toxic chemicals of the algae (rotifers), and avoidance of consumption of the algae by chemosensory feeding (copepods). Zooplankters probably promote the dominance of filamentous or colonial blue-green algae by grazing on small edible algae which compete with blue-green algae for nutrients and by releasing nutrients obtained from these algae for use by the blue-green algae. In eutrophic lakes, bloom-forming blue-green algae are considered to be hardly ingested by zooplankton. The organic matter produced by the algae is probably utilized by zooplankton through bacteria which had grown in the process of the decomposition of the algae. Thus, the main pathway of the organic matter from phytoplankton to zooplankton is detritus food-chain in these lakes. (Author's abstract)
W89-12328

HOLOLOGICAL STUDY OF LAKES FROM AN ENTROPY VIEWPOINT: LAKE MENDOTA.
Osaka Medical School, Takatsuki (Japan).Dept. of Physics.
I. Aoki.
Ecological Modelling ECMODT, Vol. 45, No. 2, p 81-93, April 1989. 3 fig, 1 tab, 30 ref.

Descriptors: *Lakes, *Limnology, *Entropy, *Thermodynamics, *Heat transfer, Seasonal variation, Energy, Eutrophication, Oligotrophic lakes, Succession, Aquatic productivity, Lake Mendato.

The monthly entropy fluxes associated with direct, diffuse and reflected solar radiation in Lake Mendota were calculated from the corresponding energy data of the lake. The monthly entropy fluxes associated with infrared radiation, evaporation and sensible heat were estimated. The net entropy flow into the lake becomes negative; that is, the lake absorbs 'negative entropy' from its surroundings. In this respect, the lake can be regarded as a 'superorganism,' which has ordered structures and functions in it similar to a biological organism. The change of entropy content is computed from the change of heat-storage and the mean temperature of the lake. From the net entropy flow and the change of entropy content, the entropy production was calculated. Entropy production is large in summer and small in winter; it oscillates with a period of 1 year. The monthly entropy production is a function of the monthly solar energy absorbed by the lake. Two constants, (a, b) are holistic indices that characterize the lake from an entropy viewpoint. Other indices of similar nature are also introduced. Comparisons of these quantities in Lake Mendota (eutrophic) with those in the northern basin of Lake Biwa (oligo-mesotrophic) showed that processes of eutrophication or succession are accompanied by the increase of magnitudes of these indices that are related to entropy production. The increase of entropy production will be an entropy principle in some stage of ecological succession in lakes, and also in other ecological systems. A hypothesis states that the whole span of ecological succession consists of three phases: developmental stage (early stage) in which entropy production increases with time; stationary stage (intermediate stage) in which entropy production is kept constant, and the senescent stage (later stage), in which entropy production decreases with time. (Author's abstract)
W89-12369

GLOBAL BEHAVIOR OF A GENERALIZED AQUATIC ECOSYSTEM MODEL.
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Experimentalenj Biologie a Ekologie.
T. Kmet, and M. Straskraba.
Ecological Modelling ECMODT, Vol. 45, No. 2, p 95-110, April 1989. 5 fig, 2 tab, 6 ref.

Descriptors: *Ecosystems, *Model studies, *Mathematical studies, *Limiting nutrients, *Primary productivity, *Cycling nutrients, *Biomass, Epilimnion, Limnology, Aquatic environment, Steady-state conditions, Phytoplankton, Zooplankton, Chlorophyll, Phosphorus.

The steady-state behavior of a simple dynamic model of an aquatic ecosystem (series AQUAMOD, model GIRL) was investigated. The model consists of three equations describing phosphorus as the limiting element, and phytoplankton and zooplankton in a uniformly mixed layer of water with specified depth (zmix). It may represent either a shallow lake or the epilimnic upper layer of a deep lake. The reservoir character is due to variable throughflow, the additional physical characteristics being represented by the extinction coefficient of water for light and annually for temperature. When throughflow is zero, the biological components vanish and only dissolved phosphorus remains. For nonzero throughflow, one asymptotically stable in the large steady state was found for every condition investigated. For periodically varying inputs, a periodic trajectory of steady-state solution for different time (t) was obtained. The behavior of the steady-state model solution (for t =210) reactions on changes of input parameter values can be measured with knowledge of the behavior of natural aquatic ecosystems. The upward curve of phytoplankton biomass observed for the relation to PRFOS parameter values was in agreement with an earlier type of chlorophyll-a:total phosphorus relationship. However, to differ from both dynamic simulation results as well as natural observations evaluated earlier, no saturation limit was observed. This is explainable while the concentrations of phosphorus in the water body at the retention time modeled (corresponding to about one year) are low. Overall, the comparison of model solutions and natural observations suggest that use of steady-state solutions for selected periods can help to study the system's reaction to various parameters. (Friedmann-PTT)
W89-12370

FACIES RELATIONSHIPS AND SEDIMENTATION IN LARGE RIFT LAKES AND IMPLICATIONS FOR HYDROCARBON EXPLORATION: EXAMPLES FROM LAKES TURKANA AND TANGANYIKA.
Arizona Univ., Tucson. Dept. of Geosciences.
For primary bibliographic entry see Field 2J.
W89-12376

QUATERNARY LAKES OF ARGENTINA.
Consejo Nacional de Investigaciones Cientificas y Tecnicas, Buenos Aires (Argentina).
M. Iriondo.
Palaeo PPPYAB, Vol. 70, No. 1-3, p 81-88, April 1989. 1 fig, 1 tab, 31 ref.

Descriptors: *Geologic history, *Sedimentation, *Sedimentology, *Lake sediments, *Swamps, *Glacial lakes, *Argentina, Playas, Geologic formations, Geologic time, Mountain lakes, Saline lakes, Glacial lakes.

Quaternary lacustrine sediments are extensive in Argentina, and show considerable diversity. The present knowledge about the main environments is synthesized from the continental regions of the country. The main source of data is the geomorphological map of South America plains. The Quaternary lakes of Argentina are grouped into eight main environments: swamps and playas of the Hernandaries Formation (Middle Quaternary of northeastern Argentina) Pampean swamps; Chaco swamps; swamps and shallow lakes of the Parana system; salt lakes of the Puna; northwestern salt lakes and playas; glacial lakes of the southern Cordillea; and Patagonian closed depressions. From this differentiation, it is concluded that the Quaternary lakes form 9.5% of the total continental surface of Argentina, and that the swamp environments constitute 75.7% of the lacustrine surfaces. The Patagonia meseta region is generally unfavorable for lake development. The closed depressions are comparatively modest in areal extent (5.5% of the total) and constitute lacustrine environments only a few weeks in the year. The sedimentation balance appears to be negative in most of them. The lacustrine environments of the plains are composed of different types of swamps. Such swamps developed under a diversity of climates, from humid tropical to arid. The lakes formed in the mountains, in contrast, are related to extreme climatic conditions: aridity (salt lakes and playas) or glaciation (deep lakes). (Friedmann-PTT)
W89-12377

HYDROGEN INDEX AND CARBON ISOTOPES OF LACUSTRINE ORGANIC MATTER AS LAKE LEVEL INDICATORS.
Bergen Univ. (Norway). Dept. of Geology.
M. R. Talbot, and D. A. Livingstone.
Palaeo PPPYAB, Vol. 70, No. 1-3, p 121-137, April 1989. 7 fig, 1 tab, 46 ref.

Descriptors: *Paleolimnology, *Geochemistry, *Lake sediments, *Sedimentology, *Stable isotopes, *Dissolved solids, Geologic time, Lakes, Water level, Photosynthesis, Aquatic plants, Particulate matter.

Optical and geochemical techniques were applied to organic matter of Late Quaternary sediments from Lakes Victoria and Rukwa, East Africa. Variations in total organic carbon (TOC) and hydrogen content (expressed as Hydrogen Index, HI) can be related to known changes in lake level and used to identify periods of very low water or subaerial exposure in basinal sequences. TOC and HI both decline as an exposure surface is approached, mainly due to the selective removal of unstable components by bacterial respiration and inorganic oxidation. Inert organic material of very low HI is typically concentrated at the overlying transgression surface. The carbon isotopic composition of the particulate organic matter tends to be less negative in sediment associated with exposure surfaces. Although weathering may be partially responsible, isotopic variations are mainly due to changes in the relative importance of material from plants using C4 photosynthesis, such as grasses and sedges, growing around the shore and on the exposed lake muds, and of material from planktonic algae and terrestrial C3 plants. (Author's abstract)
W89-12378

DISTRIBUTION OF POLYCHLORINATED BIPHENYL CONGENERS AND OTHER HALOCARBONS IN WHOLE FISH AND MUSCLE AMONG LAKE ONTARIO SALMONIDS.
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W89-12383

DISTRIBUTION, REDISTRIBUTION, AND GEOCHRONOLOGY OF POLYCHLORINATED BIPHENYL CONGENERS AND OTHER CHLORINATED HYDROCARBONS IN LAKE ONTARIO SEDIMENTS.
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
For primary bibliographic entry see Field 5B.
W89-12389

PHYSICO-CHEMICAL CHARACTERISTICS OF A COLLOIDAL IRON PHOSPHATE SPECIES FORMED AT THE OXIC-ANOXIC INTERFACE OF A EUTROPHIC LAKE.
Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
For primary bibliographic entry see Field 2K.
W89-12400

METHANE PRODUCTION, SULFATE REDUCTION AND COMPETITION FOR SUBSTRATES IN THE SEDIMENTS OF LAKE WASHINGTON.
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 2K.
W89-12401

DISTRIBUTION OF CR, PB, CD, ZN, FE AND MN IN LAKE VICTORIA SEDIMENTS, EAST AFRICA.
Nairobi Univ. (Kenya). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W89-12441

ACTIVITY OF THE RESPIRATION ELECTRON TRANSPORT SYSTEM (ETS) IN DIFFERENT SIZE PARTICLES AS A MEASURE OF CARBON LOSSES FROM PRIMARY PRODUCERS.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Oekophysiologie.
H. Rai.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 6, p 617-625, 1988. 3 fig, 4 tab, 28 ref.

Descriptors: *Respiration, *Enzymes, *Limnology, *Carbon cycle, *Primary productivity, Phytoplankton, Lakes, Trophic level, Photosynthesis, Metabolism, Particle size.

In situ ETS-activity of size-fractionated natural phytoplankton communities was studied to determine the relative rate of respiration of different size fractions. Different north German lakes of varying trophic levels were examined. This study suggested that nanoplankton and picoplankton (< 35 micron size fraction particles) contributed a large fraction of metabolic activity (respiration and primary productivity). This fraction also contributed about 76% whereas net-plankton (> 35 micron size fraction particles) contributed only 24% of the community respiration. Even picoplankton contributed more than the netplankton in the whole community respiration. Results imply that smaller organisms are metabolically more active than larger planktonic organisms in all lakes studied, and indicate that half or more of the primary productivity of different size particles is lost by their respiratory activity and therefore is not available to the higher trophic levels. The data collected during this research on the photosynthetic rates and photosynthesis to respiration ratio of different size particles give better information than primary productivity alone on community metabolic rates for evaluating productivity measurements. (Author's abstract)
W89-12456

EXPERIMENTS ON NITROGEN AND PHOSPHORUS RELEASE BY CHIRONOMUS EX GR. PLUMOSUS FROM THE SEDIMENTS OF LAKE BALATON, HUNGARY.
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
I. Tatrai.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 6, p 627-640, 1988. 11 fig, 17 ref.

Descriptors: *Lakes, *Lake sediments, *Limnology, *Nitrogen cycle, *Phosphorus, *Midges, *Hungary, Lake Balaton, Mud, Population density, Light quality, Denitrification, Larval growth stage, Nutrients, Aerobic conditions, Algae, Sediment-water interfaces, Nitrogen fixation.

Sediment-water systems of Lake Balaton mud and tap water were constructed in plexiglass tubes and boxes for evaluation of changes in the nitrogen and phosphorus contents of overlying water as influenced by chironomid density and light conditions. Nitrogen flux from sediment was greatly influenced by denitrification processes. The amount of total nitrogen released by chironomids amounted to about half of the yearly nitrogen fixation rate in Lake Balaton. Omnivorous chironomids increased the phosphorus content of the overlying water. The rate of release was density-dependent. Total phosphorus release rates ranged between 1-17 mg/sq m/d over a range of densities 500-20,000 larvae/sq m. It became evident that aerobic sediment cores can be an important nutrient source in lakes where chironomids inhabit them at densities above 1,000 larvae/sq m. (Author's abstract)
W89-12457

REMARK ON MICROORGANISMS IN LAKE SEDIMENTS WITH EMPHASIS ON POLYPHOSPHATE-ACCUMULATING BACTERIA.
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
D. Uhlmann, and H.-D. Bauer.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 6, p 703-708, 1988. 6 fig, 8 ref.

Descriptors: *Lake sediments, *Phosphorus, *Aquatic bacteria, *Bioaccumulation, Eutrophication, Electron microscopy, Sampling, Sample preparation, Activated sludge process, Microbiological studies, X-ray spectroscopy, Anaerobic conditions, Advanced wastewater treatment.

Bacteria that are able to store large amounts of phosphorus as polyphosphate (PP) under aerobic conditions and release it under anaerobic conditions are utilized for advanced wastewater treatment. Such bacteria may also be present in upper lake sediments. Sediment samples were taken from a reservoir in Germany and analyzed by electron microscopy. The simple preservation and preparation of cells and microcolonial associations were sufficient to meet the requirement for a rough discrimination between aggregations, filaments, and cells. Whereas conventional staining techniques for polyphosphates in connection with light microscopy often does not yield clear results, energy dispersive X-ray spectroscopy was found most suitable to identifying the relevant elements within the cell. In many cells, no phosphorus deposits could be detected. However, other types of bacterial cells found at different sampling dates and locations obviously included polyphosphate granules. In other samples, there were also morphological types of microorganisms, the X-ray spectra of which included phosphorus, calcium, and iron. In these cases, an adsorptive or chemical binding of P to F cannot be excluded. (Doria-PTT)
W89-12458

BACTERIOLOGICAL WATER QUALITY OF A MULTI-USE CATCHMENT BASIN ON THE AVALON PENINSULA, NEWFOUNDLAND.

Memorial Univ. of Newfoundland, St. John's. Dept. of Biology.
For primary bibliographic entry see Field 4C.
W89-12477

SEDIMENTARY RECORD OF POLYCYCLIC AROMATIC AND ALIPHATIC HYDROCARBONS IN THE WINDERMERE CATCHMENT.
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5B.
W89-12479

EQUILIBRIUM APPROACHES TO NATURAL WATER SYSTEMS--7. COMPLEXATION REACTIONS OF COPPER(II), CADMIUM(II) AND MERCURY(II) WITH DISSOLVED ORGANIC MATTER IN A CONCENTRATED BOG-WATER.
Umea Univ. (Sweden). Dept. of Inorganic Chemistry.
For primary bibliographic entry see Field 5B.
W89-12485

MATHEMATICAL MODEL OF PHOSPHATE RELEASE RATE FROM SEDIMENTS CONSIDERING THE EFFECT OF DISSOLVED OXYGEN IN OVERLYING WATER.
Tokyo Univ. of Fisheries (Japan). Dept. of Food Science and Technology.
For primary bibliographic entry see Field 5G.
W89-12489

ACIDIFICATION OF LAKES IN GALLOWAY, SOUTH WEST SCOTLAND: A DIATOM AND POLLEN STUDY OF THE POST-GLACIAL HISTORY OF THE ROUND LOCH OF GLENHEAD.
University Coll., London (England). Dept. of Geography.
V. J. Jones, A. C. Stevenson, and R. W. Battarbee.
Journal of Ecology JECOAB, Vol. 77, No. 1, p 1-23, March 1989. 9 fig, 64 ref.

Descriptors: *Limnology, *Paleolimnology, *Acid rain, *Acid lakes, *Scotland, *Cores, *Pollen, *Diatoms, Geology, Glacial lakes, Hydrogen ion concentration, Leaching, Organic matter, Granite, Radiocarbon.

Potential acidification by chemical weathering, soil leaching and organic matter accumulation in the catchment of the Round Loch of Glenhead is evaluated using diatom and pollen analysis of a radiocarbon dated sediment core. The Round Lake is situated on granite bedrock and is likely to have been sensitive to acidification throughout the post-glacial period. The lake was acid in the late-glacial period (pH 5.3-5.7). No evidence of long-term acidification in the early post-glacial period was found, and from 9000-4150 years B.P. the pH of the loch was probably between 5.3 and 5.6. In the midpost-glacial no indication of lake acidification that might be associated with peat development in the catchment was identified, and from 4100 years B.P. there is little evidence that a slight increase in pH or nutrient availability or both occurred. The pollen data conform to this pattern both in actual changes and their timing although the extremely low rate of sediment accumulation in the early Boreal period does not allow the forest succession to be followed in detail. The late-glacial diatom flora is dominated by acidophilous and circumneutral species particularly Fragilaria virescens, Cymbella perpusilla and Brachysira vitrea, and a pH of between 5.3 and 6.1 is indicated. A fundamental change in the character of the catchment occurred between about 5700 and 3400 years B. P. as blanket mires expanded and tree cover was progressively removed. Despite a clear change from mineral to acid organic soils in the catchment in the mid post-glacial, feedback mechanisms operated to maintain a lake with pH stable at 5 and above for most of the post-glacial period. With the introduction of strong acid anions associated with acid deposition after A.D. 1800 the pH fell to its present value of 4.7. (White-Reimer-PTT)
W89-12499

LAKE AND RESERVOIR MANAGEMENT.
Environmental Protection Agency, Dallas, TX. Region VI.
D. B. McDonell, and P. A. Crocker.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 931-952, June 1989. 489 ref.

Descriptors: *Literature review, *Lakes, *Reservoirs, *Water pollution effects, *Path of pollutants, *Fate of pollutants, Water quality, Nutrients, Sediments, Toxicity, Viruses, Bacteria, Protozoa, Algae, Aquatic plants, Zooplankton, Invertebrates, Fisheries.

A review of recent studies on lake and reservoir management includes: (1) Proceedings and noteworthy items; (2) Water quality studies on reservoirs, softwater lakes, seasonal changes in light penetration and spectral distribution, the role of turbidity in controlling physicochemical and biological aspects of water quality, seasonal and spatial fluctuations in dissolved oxygen, equations for predicting the reaeration rate of streams, the origin and influence of coal mine drainage on streams, a Community Degradation Index, eutrophication control, and trophic state relationships; (2) Nutrients in lakes of the central floodplain, nutrient-algal dynamics, and nitrogen and phosphorus dynamics; (3) Sediments in relation to chemical and biological factors and model studies; (4) Toxic chemicals such as heavy metals and organics; (5) Viruses, bacteria, and protozoa; (6) Algae; (7) Aquatic macrophytes; (8) Zooplankton; (9) Macroinvertebrates; and (10) Fisheries in regard to ecology, age and growth, and management. (White-Reimer-PTT)
W89-12535

DISSOLVED OXYGEN IN STEAMS AND RESERVOIRS.
Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 5C.
W89-12536

SUBSTRATE ASSOCIATED MICROFAUNA.
Pennsylvania State Univ., University Park. School of Forest Resources.
J. R. Pratt, and N. J. Bowers.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 1068-1072, June 1989. 63 ref.

Descriptors: *Literature review, *Aquatic plants, *Algae, *Aquatic habitats, *Aquatic animals, Periphyton, Artificial substrates, Sampling methods, Cores, Biomass, Diversity, Species composition, Grazing, Predation, Seasonal distribution.

Current literature on the ecology of and methodologies for determining substrate associated microfauna is reviewed. Methodologies include an estimation method for meiofauna standing stock on rocky shores, simulation experiments using Sephadex gel beads, cores, pigment analysis, and chemical extraction techniques. Ecological studies were concerned with bacterial biomass and distributions; fungi; physical factors, nutrient availability, light gradients, and flooding effects on attached algae communities; species composition and diversity measurements; grazing and predation on periphyton communities by aquatic insects; and seasonal variation and distribution of substrate associated organisms. (White-Reimer-PTT)
W89-12543

FILAMENTOUS GREEN ALGAE IN FRESHWATER STREAMS ON SIGNY ISLAND, ANTARCTICA.
British Antarctic Survey, Cambridge (England).
I. Hawes.
Hydrobiologia HYDRB8, Vol. 172, p 1-18, 1989. 10 fig, 5 tab, 50 ref.

Descriptors: *Antarctic, *Algae, *Streams, *Seasonal variation, Signy Island, Chlorophyta, Water temperature, Nutrients, Seals, Water birds, Freezing.

The streams of Signy Island are varied and extremely seasonal environments. Water flows from November/December to March/April; streams are frozen for the rest of the year. Streams usually flow through small, barren catchments and are nutrient poor, though they may enriched by dense summer populations of seabirds and seals. Temperatures are consistently low. Stream depth is maximal during the spring melt period, and declines over the rest of the summer. Vegetation usually is algal, and filamentous chlorophytes form a particularly conspicuous component. Small numbers of vegetative cells survive the long frozen period in situ. A steady increase in standing crop results in a maximum, which occurs 2-3 months after flow begins. Sloughing is the major loss mechanism and grazers are effectively absent. Three taxa of filamentous algae are common in Signy streams: species of Zygnema, Mougeotia, and Klebsormidium. The variables identified as being important in determining the spatial and temporal distributions of the three genera of filamentous chlorophytes are essentially the same as those that are important in streams in any other geographic location. However, maritime Antarctic streams are characterized by particular combinations of certain variables: (1) low concentrations of dissolved nutrients, particularly phosphorus, except where enriched by seal or sea bird activity; (2) consistently low temperatures during the 3-5 mo period of flow; (3) variable discharge with periodic freezing and drying during the period of flow; (4) prolonged winter freezing under sometimes thick snow cover; (5) spring discharge maxima associated with snow melt; (6) absence of invertebrate grazers; and (7) highly seasonal vegetative cover and a single standing crop maximum occurring in mid-summer. (Rochester-PTT)
W89-12549

EFFECTS OF NUTRIENT LIMITATION AND STREAM DISCHARGE ON THE EPILITHIC MICROBIAL COMMUNITY IN AN OLIGOTROPHIC ARCTIC STREAM.
Cincinnati Univ., OH. Dept. of Biological Sciences.
M. A. Hullar, and J. R. Vestal.
Hydrobiologia HYDRB8, Vol. 172, p 19-26, 1989. 7 fig, 2 tab, 19 ref. NSF Division of Polar Programs Grant 8320544.

Descriptors: *Arctic, *Alaska, *Flow discharge, *Limiting nutrients, *Epilithon, *Microorganisms, Oligotrophic water, Kuparuk River, Biomass, Primary productivity, Phosphorus, Bioassay, Heterotrophic microorganisms, Nitrates, Nitrogen, Tundra, Rivers.

Nutrient limitation of epilithic microbial activity is modified by stream discharge and drainage from the tundra surrounding the Kuparuk River, Alaska. During 1984, after 3 wk of whole-stream enrichment with phosphorus, autotrophic activity per unit biomass had increased in the enriched section of the stream, suggesting that phosphorus availability was limiting productivity. In contrast, after 3 wk of phosphorus enrichment during 1985, heterotrophic and autotrophic activity was similar in the control and enriched sections of the stream. However, when ammonia or nitrate and phosphorus were added to an in situ bioassay chamber for two weeks, higher community biomass and heterotrophic activity resulted. Ten days later biomass significantly dropped in the unenriched section. Nitrate levels over this period increased four-fold concomitantly with decreased stream discharge. Apparently, during 1985, nitrogen was limiting epilithic microbial community in the phosphorus enriched section of the Kuparuk River. The significantly negative relationship between nitrate concentration and stream discharge observed during 1984 supported the trends seen in 1985. The data suggest that nutrient concentrations that limit epilithic microbial activity and biomass are regulated by the stream discharge and drainage from the surrounding tundra. (Author's abstract)
W89-12550

MICROBIAL COMMUNITIES IN SOUTHERN VICTORIA LAND STREAMS (ANTARCTICA): I. PHOTOSYNTHESIS.
Department of Scientific and Industrial Research,

Taupo (New Zealand). Taupo Research Lab.
C. Howard-Williams, and W. F. Vincent.
Hydrobiologia HYDRB8, Vol. 172, p 27-38, 1989. 3 fig, 6 tab, 23 ref.

Descriptors: *Antarctic, *Streams, *Primary productivity, Microorganisms, Biomass, Limiting nutrients, Light, Photosynthesis, Victoria Land, Nitrogen, Phosphorus, Glacial streams.

The glacier-fed ephemeral streams of southern Victoria Land (approx 78 deg S, 164 deg E) are colonized by an epilithon dominated by cyanobacterial mats and films. Biomass levels often are high (> 15 microgram (ug) chlorophyll a (Chl a)/sq cm). The mat structure, pigment, and photosynthetic characteristics of these communities have been investigated on site. The mats in high light environments have a layered structure with high levels of light shielding accessory pigments in the upper layers and elevated chlorophyll a and phycocyanin concentrations in the lower layers. Photosynthetic rates per unit area (0.4-3.5 ug C/sq cm/hr) fall within the range reported for temperate communities. Photosynthesis vs. irradiance (I) curves were used to distinguish high-, intermediate-, and low-light communities. I sub k values for high-light communities were at or lower than photosynthetically available radiation recorded at midnight in the polar midsummer (circa 100 microE/sq m/sec). Photoinhibitory responses were not detected at the midday light intensities. In situ continuous nutrient enrichment experiments failed to demonstrate N or P limitation to pigment content or photosynthetic rates. It is suggested that growth of these communities is controlled by factors other than light and nutrients. (See also W89-12552 and W89-12553) (Author's abstract)
W89-12551

MICROBIAL COMMUNITIES IN SOUTHERN VICTORIA LAND STREAMS (ANTARCTICA): II. THE EFFECTS OF LOW TEMPERATURE.
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
W. F. Vincent, and C. Howard-Williams.
Hydrobiologia HYDRB8, Vol. 172, p 39-49, 1989. 3 fig, 8 tab, 23 ref.

Descriptors: *Antarctic, *Streams, *Metabolism, *Water temperature, Nostoc, Microorganisms, Cyanophyta, Biomass, Photosynthesis, Victoria Land, Fryxell Stream, Nitrogen, Phosphorus, Glacial streams, Freezing, Respiration, Chlorophyll a, Organic carbon.

Water temperatures in southern Victoria Land streams fluctuated over the range 0 to 10 C but generally lay close to freezing. In a series of controlled assays at Fryxell Stream, Taylor Valley, the benthic microbial mats showed strongly positive metabolic responses to increases in temperature well above ambient. Rates of polysaccharide and lipid biosynthesis increased with temperature over the range 0 to 25 C. Between 0 and 10 C, Q sub 10 values for the cyanobacterial mats were 1.7 to 3.2 for gross photosynthesis, 2.5 to 5.7 for respiration, 2.2 to 2.5 for acetate incorporation into lipid, 1.9 to 3.8 for glucose catabolism, and 1.9 to 2.8 for thymidine incorporation. Respiration accounted for a high percentage of gross photosynthesis, and a net respiratory loss of carbon from three communities was either induced or worsened by an increase in temperature from 0 to 10 C. The chlorophyll a content of Nostoc discs incubated for one month in darkness decreased by 27% at % c, but by 99% at 25 C. This set of assays suggests that the cyanobacterial mats contained large amounts of chlorophyll a and carbon associated with inactive or senescing cells. This unusual standing stock probably could not persist under warmer conditions, which would promote both increased respiratory losses and faster rates of bacterial decomposition. (See also W89-12551 and W89-12553) (Author's abstract)
W89-12552

NITROGEN DYNAMICS IN TWO ANTARCTIC STREAMS.
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
C. Howard-Williams, J. C. Priscu, and W. F. Vincent.
Hydrobiologia HYDRB8, Vol. 172, p 51-61, 1989. 3 fig, 8 tab, 21 ref.

Descriptors: *Antarctic, *Cycling nutrients, *Nitrogen, *Streams, Cyanophyta, Algae, Water temperature, Victoria Land, Glacial streams, Fryxell Stream, Nitrogen fixation, Biomass.

The many glacier meltwater streams of southern Victoria Land flow through catchments where life forms are almost entirely microbial. Allochthonous inputs of nitrogen from two study streams near McMurdo Sound were derived mostly from the melting glaciers (about 100-200 mg N/cu m), with some originating from N2-fixation by heterocystous cyanobacteria (maximum 939 mg N/sq m/yr). Thirty to fifty percent of the glacier-derived N was dissolved organic N and a major proportion of this was identified as urea N, which was used by the rich algal and cyanobacterial mats in the streams. A nutrient budget for Fryxell Stream was estimated, quantifying uptake of urea N and dissolved inorganic N and the release of dissolved organic (non-urea) and particulate N by the stream communities. An index of in-stream nitrogen processing in these streams, the Net Uptake Length Constant, was compared with that from temperate climates and found to be similar. Despite the influence of low temperatures (mean daily water temperature 5 C) on microbial activity, nutrient removal rates from these Antarctic streams are high because of the large standing stock of microbial biomass there. (See also W89-12551 and W89-12553) (Author's abstract)
W89-12553

BENTHIC ALGAL BIOMASS AND PRODUCTIVITY IN HIGH SUBARCTIC STREAMS, ALASKA.
Alaska Cooperative Fishery Research Unit, Fairbanks.
J. D. LaPerriere, E. E. Van Nieuwenhuyse, and P. R. Anderson.
Hydrobiologia HYDRB8, Vol. 172, p 63-75, 1989. 7 fig, 3 tab, 37 ref.

Descriptors: *Subarctic zone, *Alaska, *Streams, *Primary productivity, *Algae, Benthic flora, Comparison studies, Diatoms, Chlorophyll a, Biomass, Alkalinity, Optical properties.

Year-round measurements of the standing crop of epilithic algae (as chlorophyll a concentration) in two streams, one second and one fourth order (map scale 1:63,360), in interior Alaska (64-65 deg N) were only about one tenth that reported from streams of temperate North America. Cell densities in these streams, however, were similar to those in comparable temperate streams. Year-round domination of the benthic flora by very tiny diatoms (Achnanthes spp.) may explain the apparent disparity between low chlorophyll a content and average cell densities. Chlorophyll a standing crop in a more alkaline groundwater-fed stream, however, was higher and within the range of similarly-sized temperate streams. Maximum chlorophyll a standing crop varied positively with alkalinity in five clear-water streams where standing crop was measured on natural or artificial substrates. Seasonal mean concentrations of sestonic chlorophyll a (used as estimates of benthic algal chlorophyll a standing crop) varied directly and significantly with alkalinity among 10 clear-water streams and with phosphorus among 8/10 clear-water and 5 brown-water streams studied. During the summer, when there is little darkness, gross primary productivity (as estimated by the diurnal dissolved-oxygen method) was similar to that of northern temperate streams. Gross primary productivity also varied directly with alkalinity in five clear-water streams in this region. (Author's abstract)
W89-12554

BROADSCALE PATTERNS IN THE DISTRIBUTION OF AQUATIC AND TERRESTRIAL VEGETATION AT THREE ICE-FREE REGIONS ON ROSS ISLAND, ANTARCTICA.
Canterbury Univ., Christchurch (New Zealand). Dept. of Plant and Microbial Sciences.
P. A. Broady.
Hydrobiologia HYDRB8, Vol. 172, p 77-95, 1989. 29 fig, 57 ref.

Descriptors: *Antarctic, *Vegetation, *Flora, *Algae, Lichens, Mosses, Baseline studies, Aerosols, Saline water, Spatial distribution, Water birds, Ross Island.

Distribution patterns are presented for selected aquatic algae, and terrestrial algae, mosses, and lichens at three large, coastal ice-free regions on Ross Island (Antarctica). Each region is unique in certain aspects of its vegetation. The variation in areal and quantitative occurrence of different components of the vegetation in diverse ponds and streams, and over exposed ground surfaces, is related to the levels of marine salts in the environment, fertilization by birds, water availability, substratum type, and degree of exposure. It is apparent that major differences between the floras of different areas within individual ice-free regions on Ross Island, and between the regions themselves, are strongly influenced by the degree to which they are subjected to saline aerosols. Similar situations have been recognized in more northern, coastal continental, ice-free regions of Antarctica, particularly at the Vestfold Hills. The study has described distribution patterns at low resolution, emphasizing mainly dominant algae and broad groupings of lichens and mosses. Also, the environmental information is mostly subjective. The results serve as a base-line for future, more detailed, studies with a greater quantitative component. (Rochester-PTT)
W89-12555

COMMUNITY STRUCTURE OF BENTHIC INVERTEBRATES IN INTERIOR ALASKAN (USA) STREAMS AND RIVERS.
Alaska Univ., Fairbanks. Inst. of Arctic Biology.
M. W. Oswood.
Hydrobiologia HYDRB8, Vol. 172, p 97-110, 1989. 1 fig, 5 tab, 49 ref, append.

Descriptors: *Arctic, *Alaska, *Invertebrates, *Streams, *Rivers, *Aquatic insects, Comparison studies, Springs, Headwaters, Spatial distribution, Temperate zone, Subarctic zone, Benthic fauna.

Taxonomic composition of benthic invertebrates in interior Alaskan streams and rivers was summarized from published and unpublished data. Diptera dominate the Alaskan stream fauna and constitute a larger proportion of the benthos in Alaskan streams than in streams of temperate North America. Plecoptera and Ephemeroptera are the next most abundant in Alaskan streams, with Trichoptera generally very scarce. Several orders that occur regularly in streams in temperate North America are absent (or in very low abundance) in interior Alaskan streams. These include: Hemiptera, Odonata, Megaloptera, Coleoptera, net-spinning caddisflies, burrowing mayflies, and several families of stoneflies (Pteronarcyidae, Peltoperlidae, and Perlidae) are conspicuous by their absence and extreme scarcity. Taxonomic composition varies significantly among hydrologic regions (major watersheds) and among stream types (springs, headwater streams, small rivers, and large rivers). Only two taxa (Chironomidae and Nemouridae) significantly increase in proportional contribution from south to north while many taxa decrease. (See also W89-12557) (Author's abstract)
W89-12556

VARIABILITY OF MACROINVERTEBRATE COMMUNITY COMPOSITION IN AN ARCTIC AND SUBARCTIC STREAM.
Cincinnati Univ., OH. Dept. of Biological Sciences.
M. C. Miller, and J. R. Stout.
Hydrobiologia HYDRB8, Vol. 172, p 111-127, 1989. 6 fig, 2 tab, 58 ref. EPA Grant R808779-01.

Descriptors: *Arctic, *Subarctic zone, *Alaska, *Macroinvertebrates, *Streams, *Rivers, *Aquatic insects, Comparison studies, Spatial distribution, Imnavait Creek, Caribou-Poker Creek, Benthic

fauna, Tundra, Taiga, Freezing, Flow discharge, Environmental variation, Seasonal variation, Water temperature.

The macroinvertebrate community composition was compared in two Alaskan streams for numeric and species constancy during the ice-free period from 1981 to 1983. Imnavait Creek is a first-order arctic stream (60 deg 39 min N, 149 deg 21 m W) draining upland tundra in the foothills of the Brooks Range. Caribou-Poker Creek is a fourth-order subarctic stream (65 deg 8 min N, 147 deg 28 min W) draining the taiga forest north of Fairbanks, Alaska. The aquatic insect larvae and other macroinvertebrates were sampled with drift nets and Hess bottom samplers for four periods, each 1 week long in the ice-free season of three years. In the arctic stream, 112 species, and in the subarctic stream, 138 species, were found in a chironomid-dominated community. In any sampler period the communities contained 51-60 species in the arctic stream and 49-92 species in the subarctic stream. Among the four sample periods, on average 39% and 50% of the species were present in two sequential samples in the arctic and subarctic streams, respectively. New immigrants, never before found in the system, averaged 37% and 31% of the community, respectively. These systems are exposed to several intermediate disturbances: prolonged and variable freeze-up, extreme variation in discharge, wide diel and seasonal changes in temperature, and erosion in frazil and anchor ice. The dipterans, which compose the most numerous and variable taxonomic group, must have variable diapause, ability to grow in cold waters, and good dispersal powers, even migrating across drainages in the arctic. Much of the seasonal dominance pattern therefore appears to be stochastic. (See also W89-12556) (Author's abstract)
W89-12557

GEOCHEMICAL PROCESSES IN THE LAKE FRYXELL BASIN (VICTORIA LAND, ANTARCTICA).
Miami Univ., Oxford, OH. School of Interdisciplinary Studies.
W. J. Green, T. J. Gardner, T. G. Ferdelman, M. P. Angle, and L. C. Varner.
Hydrobiologia HYDRB8, Vol. 172, p 129-148, 1989. 12 fig, 6 tab, 32 ref.

Descriptors: *Antarctic, *Limnology, *Geochemistry, *Geohydrology, *Lake Fryxell, Victoria Land, Nutrients, Metals, Cadmium, Potassium, Magnesium, Sulfates, Nitrates, Phosphates, Iron, Cobalt, Nickel, Manganese, Copper, Ions, Weathering, Sulfides, Chemical complexation, Chemical reactions.

Major ion, nutrient, transition metal, and cadmium concentrations are presented for nine meltwater streams flowing into Lake Fryxell, a permanently stratified lake with an anoxic hypolimnion in Taylor Valley, Antarctica. For the major ions, stream compositions are considered in terms of dissolution of marine-derived salts and chemical weathering of local rocks. Although Lake Fryxell has undergone significant evaporative concentration, only calcite, of the simple salts, is predicted to precipitate. Geochemical budgets indicate, however, that large quantities of K, Mg, and SO4 also have been removed from the lake. Reverse weathering may be an important sink for K and Mg, although Mg removal from calcium carbonate phases also is likely. Assuming constancy of composition over recent geologic time, all of the salts in the Fryxell water column could have been delivered under present flows in about 3000 yr (chloride age). Comparison of nutrient concentrations in these meltwater streams with other flowing waters in the world reveals that the Fryxell streams are strikingly deficient in NO3-N but not PO4-P. The apparent nitrogen deficiency in Lake Fryxell itself can be attributed to the low annual stream loadings of this nutrient. Stream concentrations and loadings also are presented for Mn, Fe, Co, Ni, Cu, and Cd. 'Dissolved' metal concentrations correlate roughly with average crustal abundances, suggesting that chemical weathering is a the major source of these elements. Vertical metal profiles within Lake Fryxell itself appear to be governed by the formation of insoluble sulfide phases or, in the case of Mn, by MnHPO4. However, dissolved nickel levels in sulfide-bearing waters are much higher than can be explained in terms of metal-sulfide equilibria, and the occurrence of significant organic complexing of this metal in deeper waters is suspected. (Author's abstract)
W89-12558

SOME ASPECTS OF IRON CYCLING IN ANTARCTIC LAKES.
British Antarctic Survey, Cambridge (England).
J. C. Ellis-Evans, and E. C. G. Lemon.
Hydrobiologia HYDRB8, Vol. 172, p 149-164, 1989. 9 fig, 1 tab, 44 ref.

Descriptors: *Limnology, *Antarctic, *Cycling nutrients, *Iron, *Lakes, Precipitation, Sombre Lake, Amos Lake, Microorganisms, Metabolism, Oxidation-reduction potential, Lake sediments, Thermodynamics, Mineralization.

Iron occurs in extremely high concentrations in certain maritime Antarctic freshwater lakes, which seasonally develop an anoxic zone. In oligotrophic Sombre Lake, Fe(II) precipitates as Fe(III) oxyhydroxides, which bind phosphorus and return it to the sediments. In nutrient-enriched Amos Lake, significant quantities of sulfide also are produced and this binds a proportion of the released Fe(II), which reduces the ratio of total iron to phosphorus at the redox boundary where the oxyhydroxides are formed. A proportion of the sediment-released phosphorus therefore reaches the upper waters of this lake (unlike in Sombre Lake) and provides the initial nutrient source for under-ice phytoplankton development in spring. Iron-reducing bacteria have been isolated from Sombre Lake sediments that apparently utilize the abundant Fe(III) oxyhydroxides. From thermodynamic considerations (assuming Fe(III) is not limiting), these should outcompete sulfate reducers and methanogens (both previously reported from Sombre and Amos Lakes) and therefore could constitute an important component of the anaerobic mineralization of organic carbon in such lakes. (Author's abstract)
W89-12559

NITROGEN CYCLING IN ARCTIC LAKES AND PONDS.
Alaska Univ., Fairbanks. Inst. of Marine Science.
V. Alexander, S. C. Whalen, and K. M. Klingensmith.
Hydrobiologia HYDRB8, Vol. 172, p 165-172, 1989. 2 fig, 3 tab, 14 ref. NSF Grants DPP75-129481 and DPP79-00815.

Descriptors: *Arctic, *Alaska, *Cycling nutrients, *Nitrogen, *Lakes, *Limnology, *Ponds, International Biological Program, Toolik Lake, Barrow, Tundra, Oxidation-reduction potential, Limiting nutrients, Water depth.

Nitrogen cycle studies were carried out on two distinct systems in arctic Alaska. Research on the first, a series of small tundra ponds near Barrow, was carried out as part of the International Biological Program Tundra Biome Program. Research on the contrasting system, Toolik Lake, was done during the year following completion of the Barrow pond research. Toolik Lake is located on the north flank of the Brooks Range, approximately 130 km south of the Beaufort Sea coast. The two systems had some similarities, and some distinct differences, which appeared to be related to depth. Tundra ponds are very shallow, freeze to the bottom in winter and their waters are continuously in contact with the sediment. The sediment, therefore, serves as a major source of inorganic nitrogen for the phytoplankton. As a result, phosphorus rather than nitrogen deficiency is evident. In the deep lake, in situ nitrogen regeneration and allochthonous sources are important and nitrogen deficiency can occur. Both the thaw ponds and lake waters in Alaska's Arctic contain extremely low concentrations of all forms of N and are unproductive as a result. Denitrification accounts for a small loss in both environments, probably due to low NO3(-) supply in the sediment and a continuously oxic water column. Nitrification probably occurs at a low rate in the sediment and possibly in the water column in both environments based on elevated early spring NO3(-) levels, although in the ponds this probably represents primarily N imported in runoff. In Toolik Lake, the elevated concentrations are evident before runoff begins. The phytoplankton are able to sued NO3(-) more effectively in the lake than in the ponds, possibly because of greater N deficiency in lake waters. (Rochester-PTT)
W89-12560

PHOTON DEPENDENCE OF INORGANIC NITROGEN TRANSPORT BY PHYTOPLANKTON IN PERENNIALLY ICE-COVERED ANTARCTIC LAKES.
Montana State Univ., Bozeman. Dept. of Biology.
J. C. Priscu.
Hydrobiologia HYDRB8, Vol. 172, p 173-182, 1989. 2 fig, 2 tab, 26 ref.

Descriptors: *Antarctic, *Iced lakes, *Lake Fryxell, *Lake Vanda, *Phytoplankton, *Nitrogen, *Light quality, Cycling nutrients, Nitrates, Ammonia, Photosynthesis, Lakes, Mathematical models, Comparison studies, Water depth, Solute transport, Isotope studies.

15N was used to examine the influence of photosynthetic photon flux density (PPFD) on NO3(-) and NH4(+) transport by phytoplankton in the shallow and deep-chlorophyll layers of Lakes Fryxell and Vanda, Antarctica. The response observed in Lake Vanda could be modelled with a four-parameter equation previously used to model photosynthesis. Only the 9 m NH4(+) transport experiments in Lake Fryxell could be modelled with this equation. Other experiments in Lake Fryxell showed either no response to PPFD or a linear increase with no saturation at the PPFD levels used. Distinct trends were observed in transport parameters both between depths and between nitrogen species. Overall, the parameters indicate that phytoplankton in these lakes possess nitrogen transport affinities similar to those reported for other aquatic systems. (Author's abstract)
W89-12561

PATTERNS OF ENERGY STORAGE IN PSEUDOBOECKELLA POPPEI (CRUSTACEA, COPEPODA) FROM TWO CONTRASTING LAKES ON SIGNY ISLAND, ANTARCTICA.
British Antarctic Survey, Cambridge (England).
A. Clarke, J. C. Ellis-Evans, M. W. Sanders, and L. J. Holmes.
Hydrobiologia HYDRB8, Vol. 172, p 183-191, 1989. 5 fig, 2 tab, 13 ref.

Descriptors: *Limnology, *Antarctic, *Copepods, *Metabolism, *Lakes, Signy Island, Sombre Lake, Heywood Lake, Benthic fauna, Turbidity, Trophic level, Organic matter, Lipids, Seasonal distribution, Diatoms, Phytoplankton, Detritus, Comparison studies.

The copepod Pseudoboeckella poppei (Daday) (Calanoida, Centropadidae) was sampled from Sombre and Heywood Lakes on Signy Island, Antarctica (60 deg S, 45 min W) between January 1984 and March 1985. Sombre Lake is clear and oligotrophic, with little phytoplankton and a bottom sediment low in organic content. By contrast, Heywood Lake is turbid and mesotrophic; a substantial phytoplankton develops in summer and the bottom sediments are comparatively rich in organics. Both lakes freeze over for much of the year, forcing the copepods to adopt a benthic feeding strategy is over winter. Adult Pseudoboeckella feed on phytoplankton when this is available, and on detritus, diatoms, and short algal filaments stirred up from the sediment. In Heywood Lake, male copepods show a smooth seasonal trend in lipid content with lipid being synthesized in early summer and utilized in late summer and winter. The summer increase in lipid content is associated with an increase in dry weight. Female lipid contents show evidence of two peaks of egg production. In Sombre Lake both male and female copepods increase in size during summer and show a wider range of lipid contents than in Heywood Lake. It is likely that this is due to the poorer

winter feeding conditions, which necessitate the synthesis of a much larger store of reserves during the summer. In contrast to marine calanoid copepods, lipid stores are exclusively triacylglycerol, with no trace of wax ester. (Author's abstract)
W89-12562

TUNDRA PONDS OF THE YUKON DELTA, ALASKA, AND THEIR MACROINVERTEBRATE COMMUNITIES.
Seattle National Fishery Research Center, WA.
J. A. Maciolek.
Hydrobiologia HYDRB8, Vol. 172, p 193-206, 1989. 4 fig, 2 tab, 25 ref, append.

Descriptors: *Arctic, *Alaska, *Limnology, *Ponds, *Macroinvertebrates, Species diversity, Yukon Delta, Tundra, Trophic level, Aquatic insects.

The Yukon Delta, a low alluvial tundra in western Alaska, has more than 10,000 thaw-basin ponds within its 70,000 sq km area. In 1984 and 1985, 68 ponds in three interior areas of the Delta were surveyed to determine limnological features, macroinvertebrate fauna, and trophic character. Ponds ranged up to 90 ha in area, 2 m in depth, and 17 m in elevation, and occurred in various temporal stages of growth and senescence. Among the 18 major invertebrate taxa collected, in order of decreasing frequency of occurrence, Trichoptera, Hemiptera, Diptera, Pelecypoda, Isopoda, Coleoptera, Gastropoda, and Oligochaeta were found in more than 50% of the ponds. Trichoptera, the only taxon occurring in all ponds, was represented by 22 species in 6 families. The average Delta Pond had 6.6 of the 9 more common taxa. This measure of faunal richness was similar among study areas but was higher in low-tundra (sea level) ponds and in older ponds on raised tundra. In comparison, lentic invertebrate communities in five other areas of Alaskan and Canadian tundra had fewer taxa and lower average richness based on occurrence of the same nine taxa. (Author's abstract)
W89-12563

VERTICAL DISTRIBUTIONS OF A PLANKTONIC HARPACTICOID AND A CALANOID (COPEPODA) IN A MEROMICTIC ANTARCTIC LAKE.
Monash Univ., Clayton (Australia). Dept. of Zoology.
I. A. E. Bayly, and D. Eslake.
Hydrobiologia HYDRB8, Vol. 172, p 207-214, 1989. 4 fig, 4 tab, 8 ref.

Descriptors: *Antarctic, *Limnology, *Lake Abraxas, *Copepods, Dissolved oxygen, Vertical distribution, Water depth, Stratification, Ecology.

Lake Abraxas, Antarctica, (68 deg 29 min S, 78 deg 17 min E) has been cut off from the sea for about 6000 yr. In December 1985, it had an ice cover 1.38 m thick, a thermocline at 5.2 m, and zero oxygen at 17.7 m and below. The salinity of the oxylimnion was in the range 14-19 g/L. The calanoid Paralabidocera antarctica (I. C. Thompson) had a maximum density just above a thermocline at 5.0 m, at which depth adult males outnumbered females almost 3:1. Immediately beneath the ice, adult females outnumbered males 4:1. Immature copepodite stages were more abundant relative to adults near the oxycline than at higher levels. The planktonic harpacticoid, Amphiascoides sp. had a maximum density close to the oxycline at 17.2 m. There is striking spatial separation of the maximum density of the calanoid and that of the harpacticoid. The exact trophic basis for these two maxima is unknown. The harpacticoid peak corresponds with an oxygen concentration (about 2 mg/L) that may exclude or stress adult calanoids. Some harpacticoids are highly tolerant of low oxygen concentrations. (Rochester-PTT)
W89-12564

PHYSICO-CHEMICAL CHARACTERISTICS AND ORIGIN OF HYPERSALINE MEROMICTIC LAKE GARROW IN THE CANADIAN HIGH ARCTIC.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
M. Ouellet, M. Dickman, M. Bisson, and P. Page.
Hydrobiologia HYDRB8, Vol. 172, p 215-234, 1989. 5 fig, 5 tab, 87 ref.

Descriptors: *Saline lakes, *Canada, *Arctic, *Limnology, *Meromictic lakes, Saline water, Lake Garrow, Energy transfer, Marine waters, Holocene, Lake history, Freezing, Permafrost, Brine.

Garrow Lake (75 deg 23 N, 96 deg 50 W), located 3 km from the southern tip of Little Cornwallis Island in the Canadian North West Territories, and 6.7 m above mean sea level, is a meromictic ectocreno-cryogenic lake with an area 418 ha and a maximum water depth of 49 m. The thermal stratification of this lake is mesothermic (heliothermic). Some of the solar energy that penetrates through the 2 m ice cover is stored for a longer period of time in the upper level of the monimolimnion, under a greenhouse effect due to the water density gradient. The energy transfer by conduction (0.06 C/m) toward the bottom sediments is very constant from one year to the next and is likely to prevent the presence of permafrost under this water body. In its chemical composition, this meromictic lake is quite comparable to the world's saltiest water bodies and is the first lake with a salinity greater than sea water to be reported for the Canadian Arctic. Its anoxic monimolimnion is nearly three times (90 ppt) as salty as normal sea water. This hypersaline water seems to be derived from isostatic marine waters trapped within the present lacustrine basin and underground during deglaciation of the area. The subsequent freezing-out of salt from the underground waters and the migration and accumulation of these waters in the bottom of Garrow Lake through a talik within the permafrost were the main contributing factors. The speed of formation and migration of the underground brine was a function of the postglacial isostatic uplift rate as well as the permafrost growth rate. (Author's abstract)
W89-12565

MEROMIXIS IN AN ANTARCTIC FJORD: A PRECURSOR TO MEROMICTIC LAKES ON AN ISOSTATICALLY RISING COASTLINE.
Department of Science, Kingston (Australia). Antarctic Div.
For primary bibliographic entry see Field 2L.
W89-12566

CHEMICAL CHARACTERISTICS OF POND WATERS IN THE LABYRINTH OF SOUTHERN VICTORIA LAND, ANTARCTICA.
Chiba Inst. of Tech., Narashino (Japan).
T. Torii, S. Nakaya, O. Matsubaya, G. I. Matsumoto, and N. Masuda.
Hydrobiologia HYDRB8, Vol. 172, p 255-264, 1989. 5 fig, 1 tab, 27 ref.

Descriptors: *Water chemistry, *Antarctic, *Limnology, *Ponds, *Lake history, Chemical composition, The Labyrinth, Saline water, Chlorides, Freezing, Evaporation, Water loss.

A large number of freshwater and saline ponds are located in the Labyrinth (77 deg 33 min S, 160 deg 50 min E) of the upper Wright Valley in the Dry Valleys region of southern Victoria Land, Antarctica. The Labyrinth is situated near the terminus of the Wright Upper Glacier between 800 and 1000 m above sea level. From a limnological point of view, the most interesting problems concerning these saline ponds are the origin of their salts and their evolutionary history. Chloride ion contents vary remarkably among the ponds and range from 0.0049 to 52.4 g/kg. Surprisingly, more than half of the ponds are saline, with the highest chloride ion content being 2.7 times greater than that of seawater. The deltaD and delta 18O values of the pond waters indicate a snow and/or glacial meltwaters origin, and that ponds underwent subsequent alteration due to evaporation or freezing. The composition of chemical components reveals no evidence of trapped seawater. Thus, the salt concentrations in the Labyrinth pond waters must be explained principally by the accumulation of atmospheric salts and subsequent repeated cycles of evaporation and freezing of the pond waters over considerable time periods. (Author's abstract)
W89-12567

BIOGEOCHEMICAL STUDY OF ORGANIC SUBSTANCES IN ANTARCTIC LAKES.
Tokyo Univ. (Japan). Dept. of Chemistry.
G. I. Matsumoto.
Hydrobiologia HYDRB8, Vol. 172, p 265-289, 1989. 10 fig, 5 tab, 73 ref.

Descriptors: *Biochemistry, *Saline lakes, *Limnology, *Antarctic, *Organic matter, *Lakes, Geochemistry, Organic carbon, Ponds, Fatty acids, Sterols, Phenolic acids, Hydroxy acids, Lake sediments, Oxidation-reduction potential, Phytoplankton, Saline water, Decomposing organic matter.

The features of organic constituents in Antarctic lakes and ponds of the McMurdo, Syowa, and Vestfold Oases are summarized from a biogeochemical viewpoint. Total organic carbon or dissolved organic carbon contents in saline lake waters generally are extremely high and much higher than those in freshwater lakes. The concentrations and/or compositions of hydrocarbons, fatty acids, sterols, phenolic acids, and hydroxy acids in lake and pond waters and sediments vary markedly, probably reflecting differences in biological activity and source organisms. Long-chain alkenes, such as n-C29:2 (i.e., carbon chain length of 29: 2 unsaturated bonds) are the major hydrocarbons in some anoxic lake sediments. Long-chain n-alkanoic acids are abundant in some Antarctic lake sediments and 24-ethylcholest-5-en-3beta-ol is the most prominent sterol in most of the lakes studied. It is suggested that some bacteria, as well as cyanobacteria and algae, are important sources of long-chain alkanoic acids and 24-ethylcholest-5-en-3beta-ol, respectively, as previously reported from environments of the mid and lower latitudes. The dominance of p-hydroxybenzoic acid among the phenolic acids found together with the absence of syringic, p-coumaric, and ferulic acids in the Antarctic lakes reflects the absence of vascular plants in the areas studied. In three Antarctic saline lakes (Vanda, Fryxell, and Ace), the kinds and amounts of organic constituents differ with depth due to the zonation of microorganisms. The maximum fatty acid contents are found at depths just above the anoxic layer, corresponding to the photosynthetic maxima in the lakes, and the depths of maximum phytoplankton populations. In the bottom sediments of the lakes, the composition of organic substances is significantly different from that in the water columns, indicating that the sinking organic substances are degraded rapidly by microorganisms on the lake bottom. (See also W89-12569) (Author's abstract)
W89-12568

VERTICAL DISTRIBUTION OF ORGANIC CONSTITUENTS IN AN ANTARCTIC LAKE: LAKE FRYXELL.
Tokyo Univ. (Japan). Dept. of Chemistry.
G. I. Matsumoto, K. Watanuki, and T. Torrii.
Hydrobiologia HYDRB8, Vol. 172, p 291-303, 1989. 10 fig, 2 tab, 31 ref.

Descriptors: *Limnology, *Lake sediments, *Antarctic, *Organic compounds, *Lakes, Lake Fryxell, Organic carbon, Microorganisms, Hydroxy acids, Fatty acids, Bacteria, Water depth, Oxidation-reduction potential, Decomposing organic matter.

Vertical distribution of organic constituents, i.e., total organic carbon (TOC), hydrocarbons, fatty acids, and hydroxy acids, in water and sediments from Lake Fryxell (77 deg 35 min S, 163 deg 15 min E) of southern Victoria Land, Antarctica, was studied to elucidate their features in relation to stratification of the lake waters and likely distribution of microorganisms. The TOC content of the surface water (5.0 m; just below the ice cover of 4.5 m thickness) was 1.4 mg/L. It increased markedly with depth and attained a maximum value of 21.7 mg C/L at a depth of 17.5 m, but decreased toward the bottom (13.3 mg C/L). The high TOC

content of the anoxic bottom layers (> 15 m) is attributable to the concentration of refractory organic substances over long periods following the degradation of labile organic constituents. Hydrocarbons were not found in the water column, but the major constituent of the bottom sediment was n-C29:2 alkene (i.e., carbon chain length of 29: 2 unsaturated bonds). Total concentrations of fatty acids in the oxic layers (10 m or less) were highest at 10.0 m and much higher than those of the anoxic layers (> 10 m), probably reflecting the phytoplankton population. The content of branched (iso and anteiso) fatty acids and 3-hydroxy acids in the anoxic layers were much greater than those in the oxic layers, which would seem to reflect the distribution of bacterial abundance. The differences of organic composition between the water column and sediment imply that sinking dead organisms were degraded quickly in the lake bottom. Also, the composition of microorganisms in the water column must be very different from that in the sediments. (See also W89-12568) (Author's abstract)
W89-12569

PERENNIALLY ICE-COVERED LAKE HOARE, ANTARCTICA: PHYSICAL ENVIRONMENT, BIOLOGY AND SEDIMENTATION.
Nevada Univ., Reno. Desert Research Inst.
R. A. Wharton, G. M. Simmons, and C. P. McKay.
Hydrobiologia HYDRB8, Vol. 172, p 305-320, 1989. 6 fig, 1 tab, 53 ref. NSF Grant DPP-8416340 and NASA Grants NCA2-2 and NCA2-1R675-402.

Descriptors: *Lakes, *Antarctic, *Limnology, *Sedimentation, *Ice cover, *Iced lakes, *Lake Hoare, Lake sediments, Climate, Glacial streams.

Lake Hoare (77 deg 38 min S, 162 deg 53 min E) is a perennially ice-covered lake at the eastern end of Taylor Valley in southern Victoria Land, Antarctica. The environment of this lake is controlled by the relatively thick ice cover (3-5 m), which eliminates wind-generated currents, restricts gas exchange and sediment deposition, and reduces light penetration. The ice cover is in turn largely controlled by the extreme seasonality of Antarctica and local climate. Lake Hoare and other dry valley lakes may be sensitive indicators of short-term (< 100 yr) climatic and/or anthropogenic changes in the dry valleys since the onset of intensive exploration more than 30 yr ago. The time constants for turnover of the water column and lake ice are 50 and 10 yr, respectively. The turnover time for atmospheric gases in the lake is 30-60 yr. Therefore, the lake environment responds to changes on a 10-to 100-yr time scale. Because the ice cover has a controlling influence on the lake (e.g., light penetration, gas content of water, and sediment deposition), it is probable that small changes in ice ablation, sediment loading on the ice cover, or glacial meltwater (or groundwater) inflow will affect ice cover dynamics and will have a major impact on the lake environment and biota. (Author's abstract)
W89-12570

AMMONIUM EXCRETION BY SOME FRESHWATER ZOOBENTHOS FROM A EUTROPHIC LAKE.
Niigata Univ. (Japan). Faculty of Education.
H. Fukuhara, and K. Yasuda.
Hydrobiologia HYDRB8, Vol. 173, No. 1, p 1-8, March 15, 1989. 3 fig, 2 tab, 28 ref. Ministry of Education, Science and Culture (Japan) Grant-in-Aid 57030044.

Descriptors: *Limnology, *Ammonium, *Lakes, *Benthic fauna, *Cycling nutrients, *Eutrophic lakes, Water temperature, Lakes, Aquatic insects, Ammonia, Excretion, Metabolism.

Relationships between the ammonium excretion rate of zoobenthos and temperature were examined for two chironomids: Chironomus plumosus and Tokunagayusurika akamusi, one chaoborid, Chaoborus flavicans, and two tubificids, Limnodrilus spp. and Branchiura sowerbyi, which often dominate in eutrophic lakes. The representative Q sub 10 value and excretion rate (microgram N/mg dry wt/day) at 15 C for each species were as follows: C. plumosus, 1.67, 1.40; T. akamusi, 1.02 (< 15 C), 0.33; C. flavicans, 1.49, 2.87; Limnodrilus spp., 2.98, 0.59; and B. sowerbyi, 3.15, 0.79. (Author's abstract)
W89-12571

C:N:P RATIO OF PHYTOPLANKTON DETERMINES THE RELATIVE AMOUNTS OF DISSOLVED INORGANIC NITROGEN AND PHOSPHORUS RELEASED DURING AEROBIC DECOMPOSITION.
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
Y. Tezuka.
Hydrobiologia HYDRB8, Vol. 173, No. 1, p 55-62, March 15, 1989. 6 fig, 1 tab, 21 ref.

Descriptors: *Limnology, *Cycling nutrients, *Phytoplankton, *Lakes, Carbon, Nitrogen, Phosphorus, C:N:P ratio, Growth, Decomposing organic matter.

Three phytoplankton assemblages, with different C:N:P ratios of 314:55:1, 103:17:1, and 57:5.5:1 (by weight), were prepared by growing lake phytoplankton in artificial media with different N:P supply ratios and then allowing them to decompose under aerobic conditions for 3 mo. There was no net release of dissolved inorganic phosphorus (DIP) from the phytoplankton assemblage with the highest C:N:P ratio, in contrast with an abundant liberation of DIP from that with the lowest C:N:P ratio. On the other hand, there was an abundant release of dissolved inorganic nitrogen (DIN) from the phytoplankton assemblage with the highest C:N:P ratio, in contrast with little or virtually no release of DIN from those with lower C:N:P ratios. It was concluded that the C:N:P ratio of phytoplankton is an important parameter to determine the relative amounts of DIP and DIN released during decomposition of phytoplankton under aerobic conditions. (Author's abstract)
W89-12573

EFFECTS OF NUTRIENT (N, P, C) ENRICHMENT, GRAZING AND DEPTH UPON LITTORAL PERIPHYTON OF A SOFTWATER LAKE.
West Chester Univ. of Pennsylvania. Dept. of Biology.
G. W. Fairchild, J. W. Sherman, and F. W. Acker.
Hydrobiologia HYDRB8, Vol. 173, No. 1, p 69-83, March 15, 1989. 6 fig, 2 tab, 42 ref. NSF Grant BSR-8415774.

Descriptors: *Limnology, *Pennsylvania, *Nutrients, *Periphyton, *Lakes, Limiting nutrients, Carbon, Nitrogen, Phosporus, Eutrophication, Primary productivity, Chlorophyll a, Artificial substrates, Cyanophyta, Chlorophyta, Hydrogen ion concentration, Bicarbonates, Zooplankton, Lake Lacawac.

Three field experiments were performed in Lake Lacawac, Pennsylvania, to determine the importance of potentially limiting nutrients relative to other factors (grazing and depth) in structuring shallow-water algal periphyton communities. All three experiments measured periphyton growth (as chlorophyll a, ash-free dry mass (AFDM), or biovolumes of algal taxa) on artificial clay flower pot substrates which released specified nutrients to their outer surfaces. Control of standing crop by nutrient supply rate versus grazing was examined in Experiment I. Substrates releasing excess N and P, together with one of four levels of C (as bicarbonate) were placed either inside or outside exclosures designed to reduce grazer densities. Chlorophyll-a rose from 1.1-25.6 microgram (ug)/sq cm, and some dominant taxa (e.g., Oedogonium, Nostoc, and Anacystis) were replaced by others (e.g., Scenedesmus and Cryptomonas) as bicarbonate supply increased. Reductions in invertebrate density did not significantly affect chlorophyll-a at any of the nutrient levels. Reasons for the species shift were further evaluated in Experiment II, in which a minielectrode was employed to measure elevation of pH within the periphyton mat through photosynthetic utilization of bicarbonate. The pH adjacent to pots diffusing N, P, and large quantities of bicarbonate, and supporting chlorophyll-a densities of 32 ug/sq cm, averaged 10.0 compared to 6.3 in the water column. Pots diffusing only N and P supported 0.7 ug chlorophyll-a/sq cm and elevated pH to 8.2. Experiment III was designed to test the effects of depth (0.1 m vs. 0.5 m) and N (NH4(+) vs. NO3(-)) upon the growth response to bicarbonate observed in Experiments I and II. Similar standing crop and species composition were noted on pots at 0.1 m and 0.5 m. Enrichment with NH4(+) vs. NO3(-) also appeared to have little effect upon the periphyton community. (Author's abstract)
W89-12574

PHOSPHORUS IN SOIL, WATER, AND SEDIMENT: AN OVERVIEW.
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5B.
W89-12575

PHOSPHORUS IN INTERSTITIAL WATER: METHODS AND DYNAMICS.
Swedish Environmental Research Inst., Stockholm.
For primary bibliographic entry see Field 5B.
W89-12580

BIOAVAILABILITY OF DIFFERENT PHOSPHORUS FORMS IN FRESHWATER SYSTEMS.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5B.
W89-12581

PHOSPHATASES: ORIGIN, CHARACTERISTICS AND FUNCTION IN LAKES.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5B.
W89-12582

PHOSPHATE UPTAKE AND UTILIZATION BY BACTERIA AND ALGAE.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5B.
W89-12583

PHOSPHORUS AS A GROWTH-REGULATING FACTOR RELATIVE TO OTHER ENVIRONMENTAL FACTORS IN CULTURED ALGAE.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
G. Ahlgren.
Hydrobiologia HYDRB8, Vol. 170, p 191-210, December 1988. 12 fig, 95 ref.

Descriptors: *Limnology, *Phosphorus, *Eutrophication, *Algal growth, *Phytoplankton, Light, Temperature, Limiting nutrients, Lakes, Algae, Cycling nutrients.

The way the regulating effect on P on the growth of phytoplankton will be modified by other environmental factors, e.g., the physical factors light and temperature and nutrients N, Si, Se, Fe, and C is reviewed. Questions about interaction effects are considered, as well as the possibility of general description of the interaction phenomena. The general response to nutrient limitation can be considerably altered by light and temperature. The algae use relatively more P with increasing light, and the P content of the algae increases at lower temperature. The algae are, therefore, more sensitive to P limitation at high light and low temperature. The P yield at maximum specific growth rate seems to be relatively independent of temperature, but the lower the growth rate, the larger is the influence of the temperature. Two opinions exist of how dual limitation of two nutrients affects the growth rates of phytoplankton: (1) a threshold, non-interactive model where growth is controlled by a single nutrient at a time and (2) a multiplicative, interactive model where growth is controlled by both suboptimal nutrients simultaneously. Both models

are supported by different experimental data. (Author's abstract)
W89-12584

PHYTOPLANKTON BIOMASS AND PRODUCTION IN RELATION TO PHOSPHORUS.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5C.
W89-12585

EXCHANGE OF PHOSPHORUS ACROSS THE SEDIMENT-WATER INTERFACE.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
B. Bostrom, J. M. Andersen, S. Fleischer, and M. Jansson.
Hydrobiologia HYDRB8, Vol. 170, p 229-244, December 1988. 2 fig, 1 tab, 73 ref.

Descriptors: *Limnology, *Nutrients, *Phosphorus, *Lake sediments, *Sediment-water interfaces, *Cycling nutrients, Chemical reactions, Solute transport, Path of pollutants, Nitrates, Eutrophication, Precipitation, Lakes, Model studies, Reviews, Bacteria.

Principles of phosphorus retention and phosphorus release at the sediment-water interface in lakes are reviewed, including a discussion of new results and hypotheses in relation to older models of phosphorus exchange between sediments and water. Topics include: retention processes and distribution of phosphorus forms in lake sediments; release of phosphorus from lake sediments (mobilization processes, transport processes, and internal loading in different lake types); and interactions between abiotic and biotic processes (effects of microbial processes on organic and iron-bound phosphorus, release of phosphorus from microorganisms, and effects of biogenic CaCO3 precipitation on phosphorus cycling). Phosphorus exchange between sediment and water in lakes is not explainable by a single model or theory because (1) the fractional composition of sedimentary P varies considerably and (2) the prerequisites for different P mobilization and transport processes vary among lakes due to differences in morphometry. Phosphorus mobilization may proceed continuously over extended periods without release to the lake water until there is a sudden decrease in available phosphorus binding sites. Shifts from aerobic to anaerobic conditions have a number of direct effects on microbial metabolism that are significant to phosphorus mobility. The dual effect of nitrate on phosphorus exchange between sediments and water illustrates the complexity of interactions between abiotic and biotic processes. Nitrate may prevent phosphorus mobilization by maintaining a high redox potential, by competitive inhibition of phosphorus mobilizing bacteria, or by inhibition of iron reduction. On the other hand, nitrate may enhance phosphorus mobilization by stimulating bacteria capable of producing 'iron reductases.' The net effect of nitrate of phosphorus mobility may differ among sediments and at different times. Microbial processes discussed here challenge existing theories on phosphorus exchange between sediments and water, but they do not disagree with the many observations on which the Einsele/Mortimer model is based. Rather, they offer alternative explanations for well-known phenomena. (Rochester-PTT)
W89-12586

INFLUENCE OF AQUATIC MACROPHYTES ON PHOSPHORUS CYCLING IN LAKES.
Lund Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 5B.
W89-12587

INFLUENCE OF ANIMALS ON PHOSPHORUS CYCLING IN LAKE ECOSYSTEMS.
Lund Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 5B.
W89-12588

EMPIRICAL AND THEORETICAL MODELS OF PHOSPHORUS LOADING, RETENTION AND CONCENTRATION VS. LAKE TROPHIC STATE.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
I. Ahlgren, T. Frisk, and L. Kamp-Nielsen.
Hydrobiologia HYDRB8, Vol. 170, p 285-303, December 1988. 13 fig, 4 tab, 81 ref.

Descriptors: *Limnology, *Eutrophication, *Pollution load, *Trophic level, *Model studies, Management planning, Water quality control, Chlorophyll, Zooplankton, Prediction, Lakes, Theoretical analysis.

Models describing the dependence of lake trophic state on external phosphorus loading are of two general types: empiricial, steady-state models derived from statistical treatment of data from large numbers of lakes, and theoretical, dynamic models based on more or less detailed mathematical descriptions of kinetics of nutrient and population dynamics. In empirical, steady-state models, in lake P concentrations have been found to depend mainly on inflow P concentrations and water residence time. Efforts to explain the remaining variance by other factors such as iron, calcium, alkalinity, etc., generally have failed. Relations between lake P concentrations and chlorophyll may be useful for the prediction of maximum chlorophyll levels with some confidence, but large variations in the actual chlorophyll concentrations are caused by, e.g., zooplankton grazing, varying content of the algae, and limiting nutrients. Dynamic, theoretical models are more suited for the prediction of rates of response to perturbations than the empirical, steady-state models. Due to the much larger demand for input data and labor investment, these models generally are better suited as tools for formalizing and testing hypotheses, rather than for use by the water manager. Simple models with flexible structure have advantages over complex models. Both empirical and theoretical models are potentially powerful tools in eutrophication research and management. It is important for both scientists and water managers to select the optimum complexity with regard to the problem to be solved and to the resources available in each case. (Author's abstract)
W89-12589

EXPERIENCES WITH REDUCING POINT SOURCES OF PHOSPHORUS TO LAKES.
Canberra Coll. of Advanced Education, Belconnen (Australia). Water Research Centre.
For primary bibliographic entry see Field 5G.
W89-12591

EVOLVING WATER QUALITY IN A COMMON CARP AND BLUE TILAPIA HIGH PRODUCTION POND.
New Alchemy Inst., East Falmouth, MA.
R. D. Zweig.
Hydrobiologia HYDRB8, Vol. 171, No. 1, p 11-21, February 1, 1989. 2 fig, 3 tab, 20 ref.

Descriptors: *Eutrophication, *Fish ponds, *Fish, *Growth, *Water quality, Fish food, Carp, Tilapia, Turbidity, Hydrogen ion concentration, Dissolved oxygen, Phytoplankton.

Intensive polyculture of blue tilapia, Orechromis aureus, and common carp, Cyprinus carpio, was conducted to determine their growth capacity and the accompanying water quality transitions in a 376 sq m (207 cu m) fish pond without aeration or water exchange. A total of 485 fingerlings (290 tilapia and 195 carp) averaging 72 g each (total 35 kg) was stocked and fed commercial floating pellets (36% protein, 6% N) at the approximate daily rate of 3% of the fish biomass 6 days each week. The total net fish growth was 159.4 kg (4.2 t/ha) with an average growth of 199.5 g/fish through the 96-day feeding period. The s conversion ratio (weight of dry feed fed/weight of live fish growth) for the commercial feed was 1.3. Physicochemical patterns in the pond water were related directly to the rise and fall of turbidity through the course of the production trial. During one period of low turbidity, a biological inversion was evident, with pH and dissolved oxygen measured at higher levels near the pond bottom and increasingly lower toward the surface. It is postulated that settled phytoplankton formed a photosynthetically-active algal mat on the pond bottom. (Author's abstract)
W89-12592

GEOGRAPHICAL DISTRIBUTION, MORPHOLOGY AND WATER QUALITY OF CALDERA LAKES: A REVIEW.
Oregon State Univ., Corvallis. Coll. of Forestry.
G. L. Larson.
Hydrobiologia HYDRB8, Vol. 171, No. 1, p 23-32, February 1, 1989. 2 fig, 6 tab, 33 ref.

Descriptors: *Craters, *Crater lakes, *Lakes, *Limnology, *Volcanoes, Morphometry, Geography, Spatial distribution, Trophic level, Transparency.

The geographical distribution, morphometry, and water quality of lakes within large calderas (> 2 km in diameter) were evaluated through a review of literature and maps. Eighty-eight lakes in 75 calderas were located in 31 volcanic subregions. As a group, the lakes varied greatly in elevation, surface area, maximum depth, and shoreline development. The 'average' surface area was 16.9 sq km, surface elevation 873 m, depth 151.1 m, and shoreline development 1.35. Water quality ranged from ultraoligotrophic to highly eutrophic. None of the lakes had an inlet that originated outside the calderas. Most lakes did not have a surface outlet, were circular or subcircular in shape, and covered only parts of the caldera basins. Water clarity in some lakes was among the highest recorded for freshwater systems, but there are indications of possible declining clarity in some cases. Secondary volcanic activity, such as primary (hydrothermal) water and eruptions, has been associated with deteriorated water quality conditions in some lakes. (Author's abstract)
W89-12593

EFFECTS OF FLOODS ON EPILITHON AND BENTHIC MACROINVERTEBRATE POPULATIONS IN AN UNSTABLE NEW ZEALAND RIVER.
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
G. J. Scrimgeour, and M. J. Winterbourn.
Hydrobiologia HYDRB8, Vol. 171, No. 1, p 33-44, February 1, 1989. 6 fig, 3 tab, 25 ref.

Descriptors: *New Zealand, *Flood flow, *Benthic fauna, *Species composition, *Algae, Macroinvertebrates, Temporal variation, Epilithon, Biomass, Primary productivity, Animal behavior, Ashley River.

Temporal changes in epilithon biomass and benthic macroinvertebrate density were investigated in the Ashley River (South Island, New Zealand), a flood-prone river with an unpredictable discharge regime. Biomass, primary production, and respiration of the epilithic community were highest in spring when filamentous algae were present and lowest following two large floods that occurred in close succession. Sixty invertebrate species were taken in benthic samples including 24 species of Trichoptera, 15 Diptera, and 4 Ephemeroptera. Larvae of the mayfly Deleatidium (Leptophlebiidae) dominated numerically and comprised up to 83% of the fauna in any one month. Mean benthic invertebrate density was highest (9170-18,580/sq m) following long periods of low stable flow (< 30 cu m/sec) and lowest (230 sq m) after a major flood (454 cu m/sec). Reductions in benthic density occurred when flow exceeded about 30 cu m/sec, the minimum discharge at which small cobbles are moved. Refuge-seeking behaviors, flexible life histories, and effective recolonization mechanisms enable the benthos of the Ashley River to persist and recover from frequent, temporally unpredictable disturbances. (Author's abstract)
W89-12594

EFFECTS OF AN EXPERIMENTAL ACID PULSE ON INVERTEBRATES IN A HIGH ALTITUDE SIERRA NEVADA STREAM.
California Univ., Santa Barbara. Dept. of Biologi-

cal Sciences.
For primary bibliographic entry see Field 5C.
W89-12595

CLASSIFICATION AND ORDINATION OF MACROINVERTEBRATE ASSEMBLAGES TO PREDICT STREAM ACIDITY IN UPLAND WALES.
Welsh Water Authority, Bridgend. South Eastern District Lab.
For primary bibliographic entry see Field 5A.
W89-12596

EVIDENCE OF STRUCTURAL AND FUNCTIONAL ADAPTATION IN EPILITHON EXPOSED TO ZINC.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W89-12597

THERMAL STRUCTURE, HEAT CONTENT AND STABILITY OF TWO LAKES IN THE NATIONAL PARK OF RIO DOCE VALLEY (MINAS GERAIS, BRAZIL).
Universidade Estadual Paulista, Botucatu (Brazil). Dept. of Zoology.
R. Henry, and F. A. R. Barbosa.
Hydrobiologia HYDRB8, Vol. 171, No. 3, p 189-199, February 15, 1989. 6 fig, 4 tab, 29 ref.

Descriptors: *Brazil, *Heat budget, *Water temperature, *Heat transfer, Tropic zone, Seasonal distribution, Lake Dom Helvecio, Lake Carioca, Comparison studies, Tropicality index.

The thermal structure, heat content, and stability were studied in Lakes Dom Helvecio and Carioca (Brazil) during an annual cycle. The thermal structure, heat content, and stability of Lake Carioca were studied during annual cycle (September 1982 to September 1983) during diel cycles (February and July, 1980), and using long-term records (from 1976 to 1985). The highest (14.6 Kcal/sq cm) and lowest values (11.4 KCal/sq cm) for heat content were recorded in February and July, 1983, respectively. the maximum stability (92 g cm/sq cm) was recorded in November 1982; the highest value for work of the wind (227 g cm/sq cm) was recorded in February and the efficiency of heating was 0.07 g cm/cal. From 1976 to 1985, the highest heat content (15.1 Kcal/sq cm) and stability (83.4 g cm/sq cm) were recorded in February 1981 and 1983, respectively. The heat budget from 1976 to 1985 ranged from 1238 to 4491 cal/sq cm. During the diel cycles, the stability fluctuated between 62.2 and 81.4 g cm/sq cm in the summer and from 9.9 to 13.0 g cm/sq cm in the winter. The daily heat budget was 371 cal/sq cm in summer and 227 cal/sq cm in winter. The maximum heat content, stability, and work of the wind in Lake Dom Helvecio corresponded to two, four, and four times, respectively, the values in Lake Carioca. These differences can be attributed to morphometric differences in the lakes. The index of tropicality for Lake Carioca was calculated at 2.08, whereas that for Lake Dom Helvecio was 1.32. This compares with values of 1.99 for Lake Valencia, Venezuela, 1.51-1.73 for Lake Titicaca, and 1.24 for Lake Mendota, Wisconsin. (Rochester-PTT)
W89-12598

OCCURRENCE AND SIGNIFICANCE OF CLADOCERA (CRUSTACEA) IN SOME STREAMS OF CENTRAL INDIANA, U.S.A.
Indiana Univ. at Bloomington. Dept. of Biology.
P. B. Vila.
Hydrobiologia HYDRB8, Vol. 171, No. 3, p 201-214, February 15, 1989. 6 fig, 4 tab, 49 ref.

Descriptors: *Indiana, *Benthic fauna, *Waterfleas, Flow discharge, Streams, Aquatic habitats, Reproduction, Life cycles, Life history studies, Seasonal distribution, Water currents, Principal component analysis, Cluster analysis, Species composition.

Results are summarized of a preliminary study of the benthic Cladocera in the streams of three watersheds in South Central Indiana. Seventeen sites were sampled with respect to species of benthic Cladocera present, their relative abundance, population size, and population dynamics. Cladocera were present in all streams and sites in the three watersheds. Nineteen species were collected: 13 spp. of Family Chydoridae, 3 spp. of Daphniidae, 2 of Macrothricidae, and 1 of Bosminidae. Four species (Alona circumfimbriata, Chydorus brevilabis, Pleuroxus denticulatus, and Macrothrix laticornis) made up 68-96% of the specimens at all sites. Density of Cladocera ranged from 3-5200/sq m and they reproduced and maintained populations in the streams sampled. Numbers were generally high in October and early November and decreased to near zero in late December and January. The most important factor appearing to affect population sizes was discharge. Numbers at almost all sites decreased significantly after a rainfall increased discharge. A principal components and clustering analysis grouped sites with similar physical parameters in a continuum of low to high order. Sites with low numbers of Cladocera generally were shallow, narrow, and had a loose, unconsolidated substrate. Sites with high population numbers generally were deep, wide, and had a stable substrate that accumulated detritus. (Author's abstract)
W89-12599

IMPACT OF LAND USE AND NPS LOADS ON LAKE QUALITY.
Wray and Todd Interests Ltd., Houston, TX.
For primary bibliographic entry see Field 4C.
W89-12621

USE OF STOCHASTIC HYDROLOGY IN RESERVOIR OPERATION.
Bureau of Reclamation, Denver, CO. Surface Water Branch.
D. K. Frevert, M. S. Cowan, and W. L. Lane.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 334-343, June 1989. 3 fig, 2 tab, 3 ref.

Descriptors: *Stochastic hydrology, *Reservoirs, *Reservoir operation, Management planning, Case studies, Statistical methods, Hydrologic properties, Decision making, Probabilistic process.

Intelligent operation of a complex reservoir system requires that the most current mathematical techniques by incorporated into the decision-making process. One such technique is stochastic hydrology and, in particular, the use of a number of stochastically generated sequences (or traces) to provide a broader basis for management decisions during drought periods. A case is presented illustrating the use of this approach by the Bureau of Reclamation in management of the Central Valley Project in California. A series of twenty 1,000-yr stochastic traces for the Sacramento River Basin was generated using Reclamation's LST (Lane's applied stochastic techniques) computer package. The package is described in Lane and Frevert (1988). Each trace was compared to an historically based natural flow sequence and was found to preserve adequately key statistical properties. The traces were then analyzed by use of a computer program that counted the number of occurrences of a flow below a specified level over 1-yr through 10-yr intervals. Results for the twenty 1,000-yr traces provided a much more objective estimate of nonexceedance probabilities for these low flows than might have been obtained by simply plotting the computed natural flows corresponding to the historic record itself. (Author's abstract)
W89-12630

EXPERIMENTAL TEST OF NUTRIENT LIMITATION IN FRESHWATER PICOPLANKTON.
Fordham Univ., Armonk, NY. Louis Calder Conservation and Ecology Study Center.
J. D. Wehr.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 6, p 1605-1611, June 1989. 7 fig, 1 tab, 47 ref.

Descriptors: *Aquatic bacteria, *Eutrophic lakes, *Limnology, *Phytoplankton, *Limiting nutrients, New York, Nitrogen, Phosphorus, Picoplankton, Microplankton, Nanoplankton, Seasonal variation, Correlation analysis.

On the basis of correlative studies, picoplankton in Calder Lake, New York, are apparently unaffected by seasonal fluxes in nutrient (N and P) levels. In this small eutrophic lake, picoplankton (<2.0 to 0.2 microm size) and nanoplankton (<20 to >2 microm) predominate. Microplankton (>20 microm) are typically least important. Experiments were conducted in situ to test whether N, P or N/P ratios affect the predominance of these smaller organisms. Manipulations were run in 4-liter microcosms during June, July, and August 1988, corresponding to periods of increasing stratification and nutrient depletion. Following nutrient additions, phytoplankton were harvested and fractionated into three size classes. Microplankton and nanoplankton were significantly stimulated by both N (2.5 to 50 microM) and P (1 to 20 microM) additions. The severity of nutrient limitation was greatest during July. Picoplankton responded less strongly to N additions and were never P limited. These field data support laboratory studies which indicate that bacterium-sized phytoplankton use nutrients more efficiently and are superior competitors within mixed communities. (Author's abstract)
W89-12662

PEAT FIRE IN THE OKAVANGO DELTA, BOTSWANA, AND ITS IMPORTANCE AS AN ECOSYSTEM PROCESS.
University of the Witwatersrand, Johannesburg (South Africa).
W. N. Ellery, K. Ellery, T. S. McCarthy, B. Cairncross, and R. Oelofse.
African Journal of Ecology AFOEDE, Vol. 27, No. 1, p 7-21, 1989. 10 fig, 1 tab, 20 ref.

Descriptors: *Botswana, *Deltas, *Wetlands, *Peat, *Peat fires, *Flood plains, Cycling nutrients, Organic matter, Ecosystem dynamics, Habitats, Africa, Flooding, Water depth.

The progressive abandonment and desiccation of the lower Nqoga River system and its associated vegetation-covered peat deposits, has resulted in the development of subsurface peat fires. These appear to have been burning within the study area for decades and consist of a mosaic of burning fronts, the first of which burns to a depth of up to 15 cm. This relatively shallow fire destroys the bases of stems and plant rhizomes, thereby preventing re-establishment of the former plant community by vegetative growth. Deeper fires are initiated where cracks develop in the peat during drying and desiccation. The depths to which these burn are limited by peat moisture content or by the presence of an incombustible inorganic substrate. The initial collapse is some 30-40 vol. %. Further compaction is brought about by rainfall and animal trampling which may cause volume reductions of as much as 98%. The short-term consequences of subsurface peat fires include the release of plant nutrients, enhancement of soil texture and soil water retention properties, and temporary transformation of the area into a terrestrial habitat. However, physiographic changes induced by the peat fire result in its eventual reflooding. It is proposed that the time delay between burning and reflooding, and the rate and depth of reflooding, determine the nature of the habitats which form after reinundation. These processes are important in maintaining the overall structure and functioning of the Okavango Delta ecosystem. (Author's abstract)
W89-12663

OBSERVATIONS ON BLUE-GREEN ALGAL BLOOMS IN THE OPEN WATERS OF LAKE VICTORIA, KENYA.
Kenya Marine and Fisheries Research Inst., Kisumu. Kisumu Lab.
P. B. O. Ochumba, and D. I. Kibaara.
African Journal of Ecology AFOEDE, Vol. 27, No. 1, p 23-34, 1989. 7 fig, 2 tab, 52 ref. International Foundation of Sciences G/1083.

Descriptors: *Eutrophication, *Phytoplankton, *Cyanophyta, *Lake Victoria, *Kenya, *Eutro-

phic lakes, Chemical analysis, Light penetration, Nutrients, Microcystis, Chlorophyll a, Conductivity, Temperature, Dissolved oxygen, Turbidity, Correlation analysis, Management planning, Africa.

Physico-chemical data associated with algal blooms was collected for Lake Victoria in order to try to determine factors in bloom timing that can be used to identify bloom-sensitive waters. This information can then be incorporated in the design of water quality management strategies for inland water users. Data collected included temperature, dissolved oxygen, light penetration, conductivity, turbidity, photosynthetic rates, chlorophyll a, phytoplankton concentration, phosphate, and nitrate. Blue-green algae dominated the open waters of Lake Victoria during an algal bloom between February and August 1986. Microcystis sp. accounted for more than 90% of the bloom organisms with algal counts reaching a high density of 34,000 colonies per ml and chlorophyll a concentration at 77.6 microg/L. Secchi disc visibilities and the 1% light penetration were reduced to 0.2 m and 1 m, respectively. The release of nutrients from river inflows, from upwelling and from sediments into the euphotic zone, coupled with high temperatures, produced the observed blooms. The blooms subsequently declined as a result of physical flushing, temperature reduction associated with the rainy season and nutrient exhaustion. This study shows that it is possible to correlate algal blooms in Lake Victoria with the weather regime and the availability of a concentrated nutrient source. From a management point-of-view, the ability both to control and to predict such blooms must include a diverse monitoring effort on the land use, nutrient runoff, agricultural practices, industrial, urban and rural development. (White-Reimer-PTT)
W89-12664

AUTOMATIC ON-LINE GROWTH ESTIMATION METHOD FOR OUTDOOR ALGAL BIOMASS PRODUCTION.
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Electrical and Computer Engineering.
G. Guterman, S. Ben-Yaakov, and A. Vonshak.
Biotechnology and Bioengineering BIBIAU, Vol. 34, No. 2, p 143-152, June 20 1989. 5 fig, 5 tab, 28 ref.

Descriptors: *Automation, *Aquaculture, *Productivity, *Algal growth, Monitoring, Growth rates, Biomass, Oxygen balance, Laboratory equipment, Estimating, Ponds, Optimization.

Utilizing the relationship between the O2 production rate (OPR) parameter and the algal growth rate already established in the laboratory, a new on-line measuring method from which the algal growth rate in outdoor ponds can be estimated has been developed. The parameters measured during the study were pH, DO, optical density, light intensity, water and air temperature, and during a short period of time, wind velocity. An automatic data-logging/control system was used. The data obtained by this method was found to correlate well with the conventional procedures for estimating productivity by measuring the changes in biomass concentration in the culture. The new procedure seems to be superior to the latter since it can be carried out in an almost continuous way and can give immediate indication of the productivity. This method could be useful not only for biomass production plants but also in the research laboratory, and if used in conjunction with an optimization algorithm could be employed in the search for optimum growth conditions. In addition, OPR could be used to monitor on-line the photosynthetic and/or respiration activity in small research fermentors or in large-scale open systems outdoors. (White-Reimer-PTT)
W89-12668

SIGNIFICANCE OF THE AQUATIC MOSSES IN BIOGEOCHEMISTRY.
Sri Venkateswara Univ., Tirupati (India). Dept. of Geology.
For primary bibliographic entry see Field 7B.
W89-12676

WOODY SEEDLING DYNAMICS IN AN EAST TEXAS FLOODPLAIN FOREST.
Rice Univ., Houston, TX. Dept. of Biology.
D. R. Streng, J. S. Glitzenstein, and P. A. Harcombe.
Ecological Monographs ECMOAQ, Vol. 59, No. 2, p 177-204, June 1989. 12 fig, 11 tab, 73 ref.

Descriptors: *Forests, *Riparian vegetation, *Flood plains, *Flood benefits, *Flood damage, *Flood frequency, *Texas, *Trees, *Seedlings, Temporal variation. Spatial variation, Flood plain vegetation, Seasonal variation, Species diversity, Survival.

Woody plant seed deposition, seedling emergence, and the survival and growth of seedling (plants < or = 0.05 m tall) in an East Texas river floodplain forest from 1979-1984 was monitored. In addition, the relative importance of flooding, drought, fungal attack, herbivory, proximity to a conspecific adult, and shade in causing seedling mortality were estimated. Tree species fell into two major groups: (1) Heavy-seeded species, of which water oak (Quercus nigra) was the primary example, and (2) Common tree species (e.g., ironwood, Carpinus caroliniana; sweetgum, Liquidambar styraciflua; red maple, Acer rubrum; American elm, Ulmus americana) which produced large crops of light seeds which dispersed throughout the study area. During the course of the study, extensive flooding in 1979 and during 1983-1984 resulted in increases in the proportion of water oak in the seedling layer, while periods of reduced flooding during 1980-1982 allowed several of the more prolific, lighter seeded species to increase in importance. The two spring-dispersing, light-seeded species, red maple and elm, emerged late in the spring and therefore increased in relative abundance during 1984 when early floods killed seedlings of earlier emerging, autumn-dispersing species. Thus, spatial and temporal variation in understory seedling composition in this study was due largely to (1) species differences in the ability to increase rapidly in numbers during favorable periods as compared to the ability to survive stressful periods, and (2) the interaction of emergence phenology with the occurrence of environmental stress. These results demonstrate that variation in flooding or other environmental stresses can alter seedling layer species composition and may thereby influence opportunities for canopy replacement, thus helping to maintain species diversity in southern floodplain forests. (Author's abstract)
W89-12677

CLASSIFICATION AND ORDINATION OF PROFUNDAL MACROINVERTEBRATE COMMUNITIES IN NUTRIENT POOR, OLIGO-MESOHUMIC LAKES IN RELATION TO ENVIRONMENTAL DATA.
National Swedish Environmental Protection Board, Uppsala (Sweden). Environmental Quality Lab.
R. K. Johnson, and T. Wiederholm.
Freshwater Biology FWBLAB, Vol. 21, No. 3, p 375-386, June 1989. 4 fig, 5 tab, 24 ref.

Descriptors: *Benthic fauna, *Limiting nutrients, *Limnology, *Acid rain effects, *Sweden, *Lake classification, *Dystrophic lakes, *Macroinvertebrates, *Bioindicators, Data processing, Statistical analysis, Canonical correspondence analysis, Correlation analysis, Physicochemical properties.

Profundal macroinvertebrates and water chemistry of sixty-eight nutrient poor, poorly buffered lakes situated from the deciduous forests of southern Sweden to the alpine regions of the north were sampled in 1983 or 1986. Assemblages of profundal zoobenthos were classified using two-way indicator species analysis (TWINSPAN), ordinated by canonical correspondence analysis (CCA), and related to physico-chemical factors using CCA, discriminant analysis, and regression. Ninety percent of zoobenthos (TWINSPAN) groups were classified correctly using discriminant analysis. Depth, soluble reactive Si(OH)4 and HCO3(-), and phytoplankton biovolume and pH were the strongest correlates with the three discriminant functions. Regression analysis showed that depth, KMnO4 consumption, and phytoplankton biovolume were the best estimators of zoobenthos biomass in the profundal. Multivariate analyses showed species assemblages amongst the profundal zoobenthos to be good indicators of lake type, particularly depth, pH, and phytoplankton biovolume. (Author's abstract)
W89-12678

COPPER COMPLEXATION IN EUTROPHIC AND HUMIC LAKE TJEUKEMEER, THE NETHERLANDS.
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
W. Verweij, H. De Haan, T. De Boer, and J. Voerman.
Freshwater Biology FWBLAB, Vol. 21, No. 3, p 427-436, June 1989. 3 fig, 6 tab, 18 ref.

Descriptors: *Metal complexes, *Decomposing organic matter, *Limnology, *Copper, *The Netherlands, *Eutrophic lakes, Correlation analysis, Ligands, Solubility, Laboratory methods, Binding sites, Copper complexes, Scatchard plots, Algal biomass, Chlorophyll a, Particle size.

To gain insight into the copper complexing capacity in the eutrophic, humus-rich Lake Tjeukemeer, and to investigate correlations with chemical and/or biological parameters, copper complexation was measured fortnightly for 3 years, by copper titration and a copper solubilization method. Additionally, the copper speciation during titration was followed by ultrafiltration. The lake showed high ligand concentrations able to complex up to 0.000085 M Cu. Scatchard plots and affinity spectra of the titration data allowed the discrimination of at least three different binding sites. In Scatchard plots log K values ranged from 5 to 9, in affinity spectra from 4.5 to 8. The highest log K values coincided with relatively low humus concentrations and blooms of algae, mainly Cyanobacteria. However, the lack of correlation between the apparent copper complexing capacity and the chlorophyll-a concentration suggests that the apparent copper complexing capacity in the lake is not predominantly caused by the total algal biomass. The ultrafiltration experiments indicated that relatively small size fractions (< 10 nm) have the highest copper binding affinity. (Author's abstract)
W89-12680

CYST DISTRIBUTION AND EXCYSTMENT CONDITIONS FOR THE DINOFLAGELLATE PERIDINIUM PENARDII (LEMM.) LEMM. IN A RESERVOIR.
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
Z. Kawabata, and M. Ohta.
Freshwater Biology FWBLAB, Vol. 21, No. 3, p 437-444, June 1989. 6 fig, 1 tab, 21 ref.

Descriptors: *Reservoirs, *Red tide, *Limnology, *Zooplankton, *Dinoflagellates, *Japan, *Peridinium, Excystment, Population dynamics, Culture techniques, Lakes, Distribution, Viability, Distribution patterns, Water depth.

Cyst distribution and a possible excystment site of the dinoflagellate Peridinium penardii (Lemm.)Lemm. in a Japanese reservoir were surveyed. To determine the distribution of P. penardii cysts, sediment samples were collected from fifteen stations throughout the reservoir, 16 days before vegetative cell of P. penardii were found in the water column. The presence of vegetative cells of P. penardii from all lake bottom mud samples, taken from several sites throughout the reservoir and cultured in vitro, showed that viable cysts of P. penardii were ubiquitous on the bottom of the reservoir. In addition, culture bottles containing bottom mud with cysts of P. penardii were suspended at several depths at four station in the reservoir. Vegetative cells of P. penardii were found in all bottles suspended at 0.5 m and almost none deeper than 20.0 m. Water depth was a critical environmental factor in preventing excystment while temperature, light conditions, and nutrients did not appear to influence excystment. Although viable cysts of P. penardii were ubiquitous on the bottom of the reservoir, most of the

reservoir is too deep for excystment. The place where p. penardii first excysts annually was predicted to be at the head of the reservoir based on data of cyst distribution, excystment conditions and morphology of the lake basin. (White-Reimer-PTT)
W89-12681

EFFECTS OF SMALL-SCALE SEDIMENTARY PATCHINESS ON THE DISTRIBUTION OF TUBIFICID AND LUMBRICULID WORMS IN LAKE GENEVA.
Conservation de la Faune, Saint-Sulpice (Switzerland).
C. Lang.
Freshwater Biology FWBLAB, Vol. 21, No. 3, p 477-481, June 1989. 2 fig, 3 tab, 8 ref.

Descriptors: *Sediment distribution, *Ecological distribution, *Limnology, *Lake sediments, *Bottom sampling, *Aquatic populations, *Annelids, *Tubificids, *Lumbriculids, *Lake Geneva, *Switzerland, Spatial heterogeneity, Bottom profiles, Biomass, Species distribution, Distribution patterns, Mesotrophy, Oligotrophy, Sampling.

Despite the presence of an apparently homogeneous lake sediment, several chemical and biological characteristics can show significant spatial heterogeneity which is attributed, among other causes, to small-scale variations in bottom profiles. The sediment of Lake Geneva (Switzerland) consists of pillow-like formations (0.7 m wide) separated by trenches, 0.2 m wide and 0.1 m deep, over large areas. A total of 132 cores were taken at random by hand by a diver from ten sampling sites at a 40 m depth. Results showed that biomass and total abundance of tubificid and lumbriculid worms were higher on the pillows than in the trenches. Potamothrix vejdovskyi, P. hammoniensis, P. heuscheri and Tubifex tubifex were more abundant on pillows whereas Peloscolex velutinus and Stylodrilus heringianus were relatively more abundant in the trenches. These differences in species distribution suggested that organic sedimentation was higher on the pillows, and sedimentological analyses confirmed this interpretation. These results show how small-scale sedimentary patchiness can modify the results of large-scale surveys. For instance, relative abundance of oligotrophic species present on pillows indicates that Lake Geneva was mesotrophic, but according to the abundance recorded in the trenches, the lake is oligo-mesotrophic. Therefore, large-scale surveys can be biased if sampling design is not adapted to such small-scale patchiness. (White-Reimer-PTT)
W89-12683

INFLUENCE OF COPPER EXPOSURE ON PREDATOR-PREY INTERACTIONS IN AQUATIC INSECT COMMUNITIES.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 5C.
W89-12684

LONG-TERM GROWTH OSCILLATIONS OF PONTOPOREIA AFFINIS LINDSTROM (CRUSTACEA: AMPHIPODA) IN LAKE MALAREN.
National Swedish Environmental Protection Board, Uppsala (Sweden). Environmental Quality Lab.
R. K. Johnson, and T. Wiederholm.
Hydrobiologia HYDRB8, Vol. 175, No. 3, p 183-194, May 15 1989. 4 fig, 4 tab, 21 ref.

Descriptors: *Crustaceans, *Population dynamics, *Limnology, *Amphipods, *Eutrophic lakes, Macroinvertebrates, Sweden, Pontoporeia, Seasonal variation, Growth oscillations, Population density, Aquatic populations, Biomass, Benthic fauna.

There is evidence that many species exhibit cyclic population fluctuations which may be in response to long-term hydrographic cycles. This cyclic trend seems to be true for the amphipod Pontoporeia affinis which was studied to determine the population dynamics and the importance of self-regulation and other mechanisms which may be of importance for the observed growth oscillations noted in Lake Malaren. Bottom fauna samples were collected annually from two sites in Lake Malaren during the autumn (Sept.-Oct.) period, 1970 to 1985. To estimate Pontoporeia growth between years, the total body length of preserved P. affinis individuals collected between 1970 and 1985 was measured. P. affinis predominated profundal macroinvertebrate communities in the lake. Amphipod densities, at both stations studied, averaged >50% of overall total macroinvertebrate densities. The life history of P. affinis was two years, with two cohorts distinguished, both exhibiting similar patterns in annual growth. During the sixteen years of this study, amphipod growth seemed to exhibit long-term cyclic fluctuations, with periods of 9-10 yrs. at one station and 5-6 yrs. at the other. Amphipod growth was significantly (negatively) correlated with conspecific density and biomass. The mechanism(s) governing Pontoporeia populations oscillations is (are) not clear. It is postulated that changes in food availability, as the result of overgrazing, may adversely affect Pontoporeia recruitment and subsequently be observed in the form of long-term population oscillations as noted in Lake Malaren. (White-Reimer-PTT)
W89-12685

STUDY OF LOUGH CORRIB, WESTERN IRELAND AND ITS PHYTOPLANKTON.
University Coll., Galway (Ireland). Dept. of Botany.
E. P. Mooney.
Hydrobiologia HYDRB8, Vol. 175, No. 3, p 195-212, May 15 1989. 16 fig, 2 tab, 42 ref.

Descriptors: *Limnology, *Ireland, *Lakes, *Cycling nutrients, *Phytoplankton, *Productivity, *Limiting nutrients, Diatoms, Cyanophyta, Wind currents, Macrophytes, Benthic algae, Seasonal variation, Species composition.

Lough Corrib is a freshwater lake, occupying an area of 183 sq km in western Ireland. It is divided by a narrowing into an upper and lower basin which differ both in morphology and in the nature of their catchment areas: upper L. Corrib is larger and deeper and much of it overlies acidic rock; lower L. Corrib is shallower and overlies Carboniferous limestone. Water budgets for the lake were calculated using rainfall data and water flow measurements. These suggest flushout times of 173 days for the upper basin and 10 days for the lower basin. The differences between the two basins were reflected to some extent in the phytoplankton and in the nutrient cycling. The phytoplankton flora consisted of a mixed assemblage. Diatoms (mainly pennate) dominated in spring, being succeeded by blue-green algae in late summer. The spring diatom crop appears to have been limited by silicate or nitrate. Levels of phosphate changed erratically and recycling of phosphorus from lake sediments is suspected. Despite the diversity of species, cell numbers and chlorophyll a levels were low. Reductions in nutrient levels in the water were not totally explained by uptake by phytoplankton. It is suggested that the shortfall in nutrients may be due to uptake by macrophytes and benthic algae, particularly in the lower basin. The upper basin, despite being more oligotrophic in nature, showed a higher productivity per unit area than the lower basin. Strong prevailing winds apparently result in a more intimate relationship between the lake phytoplankton and the benthos. Phytoplankton species composition supports this view. (Author's abstract)
W89-12686

ROTIFER OCCURRENCE IN RELATION TO TEMPERATURE.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
B. Berzins, and B. Pejler.
Hydrobiologia HYDRB8, Vol. 175, No. 3, p 223-231, May 15 1989. 4 fig, 27 ref.

Descriptors: *Temperature effects, *Limnology, *Rotifers, *Aquatic populations, Sweden, Distribution patterns, Lakes, Ponds, Wetlands, Lotic environment, Correlation analysis, Tolerance, Population dynamics.

Information on the distribution of 225 species of planktonic, periphytic and benthic rotifers from about 350 lakes, 50 ponds, 20 pools, 15 mires and 150 running water localities in southern and central Sweden was analyzed for temperature preference and tolerance. The material was obtained during a long succession of years (1945-1982), in connection with diverse projects and occasional investigations. Correlations were obtained between temperature and occurrence of individual species using a computer. This resulted in several hundred diagrams. In this study the species included are those that were observed in at least 50 samples. It was found that most rotifers have a very wide tolerance range to temperature. Although differences in temperature dependence exist between separate species, these differences are generally less distinct than what has been found for the distribution within individual lakes. It was concluded that temperature generally does not solely decide when and where a species may occur or not. Its influence ought mainly to be of an indirect nature enhancing or retarding development and cooperating with other abiotic and biotic factors. (White-Reimer-PTT)
W89-12687

RELATIONSHIPS BETWEEN LEVELS OF RADIOCAESIUM IN COMPONENTS OF TERRESTRIAL AND AQUATIC FOOD WEBS OF A CONTAMINATED STREAMBED AND FLOODPLAIN COMMUNITY.
Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 5B.
W89-12688

MORTALITY AND PRODUCTION OF 0+ PERCH, PERCA FLUVIATILIS L., IN TWO SCOTTISH LAKES.
Aberdeen Univ. (Scotland). Dept. of Zoology.
J. W. Treasure.
Journal of Fish Biology JFIBA9, Vol. 34, No. 6, p 913-928, June 1989. 4 fig, 7 tab, 39 ref.

Descriptors: *Fish populations, *Perch, *Scotland, *Mortality, *Productivity, Larvae, Predation, Food availability, Year classes, Model studies, Growth stages, Spawning, Turbulent flow.

Mortality of 0+ Eurasian perch was measured directly from the decline in catch in a high-speed plankton sampler and described by a negative exponential model. A mean mortality of 0.063/day (range=0.020-0.089) was calculated; for 0+ juveniles it was 0.021/day. Mean larval production was 0.85-1.30 mg dry weight/sq m/day in Loch Kinord and 0.08-0.12 in Loch Davan. Annual production of 0+ juveniles was 1.97-7.55 kg wet weight/ha at L Kinord and 1.01 kg at L. Davan. The contribution of 0+ perch, including the egg stages, to total perch production was 88-96%. Availability of food items on transition to exogenous feeding and through the larval period did not limit survival. Cannibalism by adults accounted for most of larval mortality, and predation by pike and adult perch were responsible for the majority of juvenile losses. The population structure of adult perch, for 12 year classes, was stable at L. Kinord, while year classes at L. Davan exhibited fluctuations in abundance and in two sampling years were eliminated in the first summer. Survival in the eleutheroembryonic phase was variable at L. Davan and observed to be low compared with L. Kinord. It is suggested that this was a result of water turbulence on the exposed and shallow spawning areas at L. Davan. (Author's abstract)
W89-12694

SIMULATION OF BACTERIAL ATTRACTION AND ADHESION TO FALLING PARTICLES IN AN AQUATIC ENVIRONMENT.
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
G. A. Jackson.
Limnology and Oceanography LIOCAH, Vol. 34, No. 3, p 514-530, May 1989. 16 fig, 1 tab, 37 ref. Office of Naval Research contracts N00014 85-K-0473 and N00014 87-k-0005.

Descriptors: *Simulation, *Aquatic environment, *Behavior, *Limnology, *Nutrients, *Aquatic bacteria, *Particulate matter, Algae, Phytoplankton, Chemosensory movement, Adhesion, Attraction, Model studies.

Chemosensory movement of bacteria toward the cloud of leaked material around planktonic algae has been suggested as an important aspect of bacterial nutrition in aquatic ecosystems. Inability of bacteria to keep pace with falling algae has been suggested as inhibiting such interactions. The interaction between bacteria and falling particles, including microalgae, is explored with a simulation model of bacteria chemotaxis that incorporates low Reynolds number fluid flow and resulting substrate spatial distributions. Results show that although bacteria cannot maintain a position relative to a falling particle unless the particle is extremely large, such as a marine snow aggregate, chemosensory response does allow them to stay in the high substrate environment of the leaky particle longer than if they did not have it. The ecological significance for bacterial metabolism depends on several factors, including the frequency of contact between algae and bacteria and the relative concentrations of substrate at the cell surface and in the background. Optimal enhancement should occur in eutrophic conditions of large algal cells present in high abundances. Presently available values for the ratio of substrate concentration next to the algal cell relative to that in solution are not large enough to suggest that the microzones around algal cells provide significant enhancement of bacterial nutrition. Chemotaxis should enhance interactions with large marine snow aggregates, both by allowing bacteria to stay for significant periods around them and by enhancing the rates at which bacteria attach to the aggregate surfaces. This enhancement is greater for surfaces in which there is a lower probability of sticking. (Author's abstract)
W89-12701

ANNUAL PRODUCTION OF CREEK CHUB AND SOUTHERN REDBELLY DACE IN A SMALL WOODLAND STREAM.
Illinois Natural History Survey, Sullivan. Sullivan Lab.
T. W. Storck, and W. T. Momot.
Ohio Journal of Science OJSCA9, Vol. 89, No. 3, p 55-61, June 1989. 1 fig, 6 tab 18 ref.

Descriptors: *Productivity, *Stream biota, *Forest watersheds, *Fish populations, *Chubs, *Dace, Biomass, Growth, Seasonal variation, Acid streams, Ohio, Growth stages, Population dynamics, Juvenile growth stage, Fish diets, Food chains.

The annual production of the creek chub, Semotilus atromaculatus, and the southern redbelly dace, Phoxinus erythrogaster, was measured in a small headwater stream in southeastern Ohio. Population estimates, using Bailey's modification of the Petersen mark-and-recapture method, were made in October 1971 and in April and October 1972 over the entire stream. A variable voltage, pulsating, direct-current electric shocker was the principal collecting gear, although small cylindrical minnow traps were also used in one area. Creek chub annual production was 13.60 g/sq m/yr, and production/biomass was 1.16. Dace annual production was 2.77 g/sq m and production/biomass was 1.82. Most growth in length and weight of both species occurred during the summer. Creek chub grew faster than did redbelly dace, and by the fall of the fourth year of life chubs were about five times heavier than dace of the same year. More than half of the production of both species was estimated to occur within the first six months of the life of the cohort. Even though the stream was acidic (pH 6.3) and infertile, fish production compared favorably with that of small alkaline streams. Considerable production within allochthonous food chains probably overrides the effects of low in-stream fertility. (White-Reimer-PTT)
W89-12707

PURPLE LOOSESTRIFE (LYTHRUM SALICARIA) IN OHIO'S LAKE ERIE MARSHES.
Ohio Cooperative Fish and Wildlife Research Unit, Columbus.
G. R. Balogh, and T. A. Bookhout.
Ohio Journal of Science OJSCA9, Vol. 89, No. 3, p 62-64, June 1989. 2 fig, 1 tab, 7 ref.

Descriptors: *Purple loosestrife, *Ohio, *Wetlands, *Marsh plants, *Introduced species, *Lake Erie, Flooding, Glyphosate, Cultivation.

Purple loosestrife (Lythrum salicaria) is an exotic plant from Eurasia that has displaced more than 50% of the plant biomass in some wetland communities in the U.S. Its dense stands provide poor waterfowl and muskrat (Ondatra zibethicus) habitat. True-color 35-mm photographs (slides) taken at 1,500 m were used to map the distribution of purple loosestrife in Erie, Lucas, Ottawa, and Sandusky Counties, where most of the purple loosestrife in Ohio occurs. There were 213 stands (0.4-60.2 ha in size) identified that comprised 1,287 ha of purple loosestrife. Stands were associated with areas that have been inundated because of high Lake Erie water levels since 1975. Within the study area, only those marshes that undergo annual treatment of glyphosate or are cultivated contain no purple loosestrife. (Author's abstract)
W89-12708

SEASONAL VARIATIONS IN ORTHOPHOSPHATE AND INORGANIC NITROGEN IN A WESTERN KENTUCKY CYPRESS SWAMP (MURPHY'S POND).
Murray State Univ., KY. Dept. of Biological Sciences.
J. M. King, C. D. Wilder, and J. McCandless.
Transactions of the Kentucky Academy of Science TKASAT, Vol. 50, No. 1-2, p 51-54, March 1989. 1 fig, 2 tab, 10 ref.

Descriptors: *Phosphates, *Nitrogen, *Cypress swamps, *Kentucky, *Nutrients, Limiting nutrients, Ammonium, Macrophytes, Seasonal variation, Phosphorus, Nitrates, Nitrites, Submerged plants.

Inorganic nitrogen and PO4-P were monitored at three sites over a seasonal cycle in a spring-fed swamp (Murphy's Pond) in western Kentucky. Concentrations of NO3-N + NO2-N ranged from <0.010 to 0.800 mg/L near the inflow of the spring, but were below 0.010 mg/L elsewhere in the swamp. Ammonium nitrogen concentrations varied from <0.01 to 0.242 mg/L and exhibited an overall decline from high levels in early spring. Concentrations of PO4-P ranged from 0.30 to 0.174 mg/L with high levels occurring in late autumn. The ratio of total inorganic nitrogen to PO4-P did not exceed 10 for any of the sites. This suggests that nitrogen was perhaps the primary limiting nutrient in the surface waters of this ecosystem, which is not an uncommon occurrence in cypress swamps. However, in spite of the relatively low nitrogen concentrations, profuse growths of submerged aquatic macrophytes occurred throughout one site from April to September, but not elsewhere in the swamp. The low NO3-N + NO2-N concentrations at this site may have resulted from assimilation by these plants, while the autumn increase reflected a decreased demand resulting from their senescence and death. (White-Reimer-PTT)
W89-12710

CONSIDERATIONS ON THE ACCLIMATIZATION OF CASPIAN SEA INVERTEBRATES IN THE DNIEPER AND ITS RESERVOIRS (ITOGI AKKLIMATIZATSII BESPOZVONOCHNYKH KASPIISKOI FAUNY V DNIEPER I EGO VODOKLRANILISCHAKH).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
I. V. Pligin, and L. V. Emelyanorn.
Gidrobiologicheski Zhurnal GBZUAM, Vol. 25, No. 1, p 3-11, 1989. 2 tab, 30 ref. English summary.

Descriptors: *Acclimatization, *Macroinvertebrates, *Caspian Sea, *Dneiper River, *Dneiper reservoir, *Limnology, *Reservoirs, Gammarus, Molluaks, Amphipods, Crustaceans.

Of the 25 species of macroinvertebrates of the Caspian fauna (Polychaeta, Gammaridae, Mysidae, Cumacea and Molluscae) introduced to the Dnieper River and its reservoir in 1940-1960, 12 species were naturalized and acclimated, and formed highly productive communities. Unstable acclimation was observed in four species. More than 30 cases of acclimation of species, which were not the basic objects of introductions, were also observed. The areas inhabited by Caspian invertebrates in the Dnieper reservoirs have been expanding considerably for the past 10 years. This is apparently due to the convergence of certain hydrochemical characteristics of the reservoirs and water bodies from which the material for introduction was sampled. (Author's abstract)
W89-12715

INITIAL MICROPERIPHYTON PRODUCTION IN THE RESERVOIR/COOLANT OF AN ATOMIC POWER STATION (PERVICHNAIA PRODUKTSIIA MIKROPERIFITONA VODOEMA-OKHLADITELYA ATOMMOI ELEKTROSTANTSII).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
R. A. Kalinichenko.
Gidrobiologicheski Zhurnal GBZUAM, Vol. 25, No. 1, p 11-16, 1989. 1 tab, 14 ref. English summary.

Descriptors: *Cooling ponds, *Epiphytes, *Nuclear powerplants, *Productivity, *Photosynthesis, *Chernobyl Atomic Power Station, Diurnal variation, Powerplants, Reservoirs, Cooling water.

Data were obtained on the intensity of the photosynthesis and destruction processes, composition of mass species of microperiphyton as well as indices of their quantitative development in the coolant water body of the Chernobyl Atomic Power Station. Values of diurnal P/B-coefficients of microperiphyton are presented. (Author's abstract)
W89-12716

GENUS ENCHELYODON CL. ET L. OF INFUSARIA IN THE BENTHIC COMMUNITY OF A KIEV RESERVOIR (INFUZORII RODA ENCHELYODON CLET L. V SOOBSHCHESTVAKH BENTOSA KIEVSKOGO VODOKHRANILISHCHA).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. A. Kovalchuk.
Gidrobiologicheski Zhurnal GBZUAM, Vol.25 , No. 1, p 26-31, 1989. 3 fig, 3 tab, 19 ref. English summary.

Descriptors: *Reservoirs, *Limnology, *Protozoa, *Benthos, *Biodegradation, Decomposition, Decomposing organic matter.

In spite of their small abundance, Enchelyodon play a significant role in the transformation of organic matter in benthic biodegradation in reservoirs in Kiev. Thus E. nataliae mineralizes 2% of the entire organic matter subject to decommposition. On the whole, the community which contains this organism can consume 50-70% of the production of heterotrophic flagellates, 15-25% of bacterial production and 15-20% of phytomicrobenthos production, as well as up to 70% of total protozoa production. Several members of the genus (E. czoriki, E. nataliae, E. foissneri) are described. (Author's abstract)
W89-12718

AMBIANCE OF THE FRESH WATER SPONGE IN DNIEPER-DONBASS CHANNEL (KONSORTSIIA PRESNOVODNOI GUBKI V KANALE DNEPR-DONBASS).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
T. A. Kharchenvo, A. V. Liashchenko, and O. A. Davydov.
Gidrobiologicheski Zhurnal GBZUAM, Vol. 25, No. 1, p 31-35, 1989. 2 fig, 13 ref. English summary.

Descriptors: *Benthos, *Dnieper-Donbass channel, *Sponges, *Hydrobiology, Algae, Chlorella, Invertebrates.

The complex of organisms occurring in the benthos of the Dnieper-Donbas channel together with fresh-water sponge Spongilla lacustris L. was studied. Oligochaete worms, larvae of rattlepots and caddisfly, nymphs of water ticks, equipods are among invertebrates observed and Chlorella is among the algae. The whole complex is considered as a consortium of aquatic organisms, where the sponge serving as the determinant and the Chlorella having a subordinate role are the core of this consortium. (Author's abstract)
W89-12719

SPECTRAL BRIGHTNESS OF INLAND RESERVOIRS AND ITS CORRELATION WITH THE PHYTOPLANKTON CONTENTS AND HYDRO-OPTICAL CHARACTERISTICS (SPECTRAL' NAIA IARKOST' VNUTRENNIKH VODOEMOV I II VZAIMOSVAIZ' S SODERZHANIEM FITOPLANKTONA I GIDROOPTICHESKIMI KHARAKTERISTIKAMI).
Institute of Biophysics, Krasnoyarsk (USSR).
A. F. Sidko, and V. A. Vasilev.
Gidrobiologicheski Zhurnal GBZUAM, Vol. 24, No. 5, p 67-75, 1988. 7 fig, 12 ref. English summary.

Descriptors: *Reservoirs, *Transparency, *Optical properties, *Remote sensing, *Phytoplankton, Chlorophyll, Dnieper Reservoir, Krasnoyarsk Reservoir, Diatoms, Algae, Pyrrophyta, Cyanophyta.

A correlation of spectral brightness coefficients with the indices of vertical attenuation of horizontal irradiance, water transparency, phytoplankton chlorophyll content and distribution, as well as with other hydro-optical characteristics, has been established. The data were obtained from long-term investigations carried out in the Krasnoyarsk Reservoir and in a cascade of the Dnieper reservoirs. When diatoms and pyrrophytes predominate the maximum of spectral brightness coefficients are in the range of 580 nw; when blue-green algae predominate, the maximum coefficients are in the region of 550 nm and 720 nm. The red band region of chlorophyll absorption is the most promising for the remote evaluation of chlorophyll concentrations in water bodies with low transparency. (Author's abstract)
W89-12726

PERIPHYTIC ALGAE: 1. DIURNAL PRODUCTIVITY AND N2 FIXATION BY MICROALGAE COLONIZED ON AN ARTIFICIAL SUBSTRATUM.
Glasgow Univ. (Scotland). Dept. of Zoology.
N. T. Chellappa.
Proceedings of the Indian Academy of Sciences (Plant Sciences), Vol. 99, No. 1, p 43-50, February 1989. 1 fig, 3 tab, 23 ref.

Descriptors: *Limnology, *Primary productivity, *Nitrogen fixation, *Lakes, *Algae, *Diurnal distribution, Chlorophyll a, Artificial substrates, Glass slide method.

The colonization of microalgae on an artificial substratum was successfully carried out by glass-slide method. After 30 days of colonization, a detailed investigation was undertaken to evaluate the diurnal chlorophyll a content, productivity and N2 fixation. Filamentous, heterocystous blue-green algae were predominant on the glass-slide and pennate diatoms formed a sub-dominant group. The diurnal productivity pattern of periphytic algae showed an initial increase, followed by a characteristic mid-afternoon dip, a peak at 16:00 h and a decrease thereafter. Higher primary production was observed in 2 microg/L of nitrate and phosphate amended series and inhibitory trend at higher concentration. The pattern of nitrogenase activity showed a strong correlation to temperature variation and the chlorophyll a content. C14 (Na2HC14O3) method wa employed for primary productivity and acetylene reduction technique for nitrogenase activity. The results were analyzed statistically using the t-test ($t = 32.53$, 5 d.f. $P < 0.001$). (Author's abstract)
W89-12748

TOXIC CYANOBACTERIA IN GREEK FRESHWATERS.
Thessaloniki Univ., Salonika (Greece). Inst. of Botany.
T. Lanaras, S. Tsitsamis, C. Chlichlia, and C. M. Cook.
Journal of Applied Phycology, Vol. 1, No. 1, p 67-73, April 1989. 1 fig, 1 tab, 19 ref.

Descriptors: *Cyanophyta, *Toxins, *Algal toxins, *Lakes, *Greece, *Toxicity, Mice, Anabaena, Anabaenopsis, Microcystis.

Cyanobacterial scums, collected in 1987 from four Greek freshwater lakes, were examined for their toxicity to mice. Species of Microcystis, Oscillatoria, Anabaenopsis and Anabaena were dominant in the samples. All samples tested had toxic effects on mice after intraperitoneal injection. The lethal dose (LD50) ranged from 40 to 1500 mg cyanobacterial dry weight per kg body weight and gross pathological signs of poisoning were characteristic of cyanobacterial heptatoxins. The toxicities of the Greek cyanobaterial blooms were similar to those reported for blooms elsewhere in the world, shown to be responsible for the poisoning of wild and domestic animals. It is shown that toxic cyanobacterial blooms occur in Greece. Evidence is provided for the first time that Anabaenopsis milleri and Anabaena viguieri are potentially toxic cyanobacteria. The toxins present in the samples appear to be hepatotoxins, on the basis of survival time after injection and enlarged darkened livers. (Miller-PTT)
W89-12755

INORGANIC CHEMISTRY OF PEAT FROM THE MAUNACHIRA CHANNEL-SWAMP SYSTEM, OKAVANGO DELTA, BOTSWANA.
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Geology and Botany.
T. S. McCarthy, J. R. McIver, B. Cairncross, W. N. Ellery, and K. Ellery.
Geochemica et Cosmochimica Acta GCACAK, Vol. 53, No. 5, p 1077-1089, May 1989. 13 fig, 7 tab, 36 ref.

Descriptors: *Inorganic compounds, *Alluvial fans, *Swamps, *Sediments, *Botswana, *Evapotranspiration, *Wetlands, *Peat, Channels, Floods.

The Okavango Delta is a large (18,000 sq km), low gradient (1:3600), alluvial fan situated in the semi-arid Kalahari basin of northern Botswana. Seasonal floodwaters from tropical Angola disperse on the fan creating both perennial (6000 sq km) and seasonal (7000 to 12,000 sq km) swamps. Ninety-five percent of this water is lost annually by evapotranspiration. Organic rich sediment (peat) is a major sediment of the perennial swamps. Peat formation commences during senescence of the plants, when certain nutrients are recycled while others are lost by rainwater leaching. Further changes in chemistry occur during subaqueous decay of the plants which involve both gains and losses of constituents. Decaying plants trap detrital mineral matter which becomes an integral part of the peat. The main sources and forms of inorganic matter in the peat are allochthonous kaolinite (40%) and quartz (20%) and both allochthonous and autochthonous phytolithic silica (30%). Several inorganic components (Fe, K, P, Na, Ca, and Mg) which make up the remaining 10% are associated with the organic fraction. Ion exchange plays only a minor part in their uptake and it seems that these metals are taken up during bacterial activity in the peat. The weight proportion of inorganic matter (ash) decreases downstream, mainly due to a decrease in allochthonous mineral matter. Volume percentage also decreases but is low throughout, generally less than five percent. It is revealed that the low-quantity allochthonous mineral matter is the main reason for the long-term survival of this ecosystem. Uptake of soluble ions by the peat is important in off-setting evaporative concentration of metals. (Author's abstract)
W89-12761

ECONOMIC ANALYSIS OF WATER HYACINTH PRODUCTION AND CONVERSION TO METHANE: THE POTENTIAL FOR LAKE RESTORATION.
Florida Univ., Gainesville. Dept. of Food and Resource Economics.
C. M. Fonyo, W. G. Boggess, C. F. Kiker, and J. W. Mishoe.
Journal of Environmental Management JEVMAW, Vol. 28, No. 4, p 337-347, June 1989. 3 fig, 3 tab, 12 ref.

Descriptors: *Lake restoration, *Water hyacinth, *Economic evaluation, *Methanogenesis, Eutrophication, Biomass, Methane, Lake Apopka, Florida, Energy sources.

Lake Apopka, a hyper-eutrophic lake in central Florida, has been the target of much study and political discourse over a 25-year period, but high costs have deterred restoration activities. The potential of harvesting water hyacintha (Eichhornia crassipes) from Lake Apopka is investigated for possible conversion of harvested biomass to pipeline quality methane gas to defer some of the costs of lake restoration. The study is based on biological and technological studies undertaken by multidisciplinary teams working under a broad project coordinated by the Gas Research Institute and the University of Florida. Computer modeling of biomass production and conversion to methane (BIOMET) was used to investigate the operating strategies, management and financing of a facility on Lake Apopka. Results indicate substantial quantities of nutrients can be removed, and over a period of approximately 15 years, water quality objectives can be met. When compared with current natural gas prices, it does not appear that methane gas can be produced competitively from water hyacinth biomass. If, however, public compensation for water quality improvement is provided, a water hyacinth production and gas conversion system has potential. (Author's abstract)
W89-12762

MODELLING PHOTOSYNTHESIS AND OXYGEN IN A SHALLOW, HYPERTROPHIC LAKE.
Agricultural Univ., Wageningen (Netherlands).
E. H. S. Van Duin, and L. Lijklema.
Ecological Modelling ECMODT, Vol. 45, No. 4, p 243-260, June 1989. 4 fig, 2 tab, 26 ref, append.

Descriptors: *Model studies, *Monod term, *Eutrophic lakes, *Photosynthesis, *Dissolved oxygen, Primary productivity, Aquatic productivity, Shallow water, Oscillatoria, Limiting nutrients, Respiration, Cyanophyta, Simulation.

Primary production and respiration models were calibrated through parameter estimation methods and applied to an extensive data set on a population dominated by Oscillatoria agardhii, a blue-green algae. Primary production is described as a function of temperature, irradiance and nutrient availability; respiration as a function of temperature. Modeling of the dissolved oxygen concentrations is simulated for a period of 45 days. This includes continuously registered water quality variables at four depths at a specific site in the lake. The results demonstrated that inclusion of the frequently used Monod term to represent phosphate limitation deteriorated the model results and caused a negative temperature effect for the primary production rate. This can be attributed to the temperature effect upon the recycling of phosphate and its actual concentration. Inclusion of the production and respiration model in an overall lake dissolved oxygen concentration model yielded a good agreement between observed and simulated concentrations. (Author's abstract)
W89-12772

PREDICTION OF INVERTEBRATE COMMUNITIES USING STREAM MEASUREMENTS.
Freshwater Biological Association, Wareham (England). River Lab.
J. F. Wright, P. D. Armitage, M. T. Furse, and D. Moss.
Regulated Rivers Research and Management

RRRMEP, Vol. 4, No. 2, p 147-155, 8 July 1989. 3 fig, 1 tab, 12 ref.

Descriptors: *Water quality management, *Bioindicators, *Invertebrates, *Computer models, Environmental policy, Prediction, Taxonomy, River systems, Pollution index, Great Britain.

A computer-based system was developed for prediction of the invertebrate fauna to be expected at unpolluted sites using environmental features. The variables for use in prediction and the flexibility of the output, with respect to taxonomic level, are demonstrated using an early version of the system which has been tested within the water industry. The practical value for river management of predictions of species, families, and biological indices, e.g. for possible identification of the presence of pollutants, is elaborated. In addition, the relevance of the system throughout Great Britain for setting target values of a biological index is demonstrated. A new version of the prediction system has recently been developed. It has application over a wider range of river systems and incorporates additional options for prediction, as requested by the Water Industry. Further developments of the system to make it more efficient for operational use are now under active consideration. (Author's abstract)
W89-12914

OBSERVATIONS ON FEEDING RELATIONSHIPS BETWEEN FISH PREDATORS AND FISH ASSEMBLAGES IN A MEDITERRANEAN STREAM.

Barcelona Univ. (Spain). Dept. of Animal Biology.
A. deSostoa, and J. Lobon-Cervia.

Regulated Rivers Research and Management RRRMEP, Vol. 4, No. 2, p 157-163, 8 July 1989. 1 fig, 4 tab, 15 ref.

Descriptors: *Predation, *Fish, *Stream biota, Fish populations, Diets, Fish behavior, Trophic level, Feeding rates, Food chains, Environmental effects, Spain, Mediterranean area.

The diet of native and introduced fish predators has been examined in contrasting localities of a very fluctuating, Mediterranean stream, in relation to fish (prey) assemblage structure. The general patterns of all six species studied seem to be the result of a generalist-opportunist behavior as their diets reflect the relative abundance of prey (fish) in the environment. The trophic levels are not well defined because of the opportunistic feeding of the predators and are also subjected to environmental changes. Non-competitive dynamics is suggested to operate throughout the trophic web. (Author's abstract)
W89-12915

FISH POPULATION DYNAMICS IN THE RIVER FROME, DORSET.

Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
R. H. K. Mann.

Regulated Rivers Research and Management RRRMEP, Vol. 4, No. 2, p 165-177, 8 July 1989. 9 fig, 3 tab, 30 ref.

Descriptors: *Fish populations, *Salmon, *Population dynamics, *Aquatic productivity, Primary productivity, Secondary productivity, Flow system, River systems, Inorganic compounds, Growth kinetics, Water temperature, Seasonal variation, Spawning, Discharge capacity, Species composition, Fish behavior, Pike, Predation, Fisheries, Macrophytes, Flood control, Roach, Aquatic weed control.

The influence of biotic and abiotic factors on the population dynamics of salmonid and non-salmonid (coarse) fish in a chalk river are examined. The naturally regulated flow regime, allied to a supply of water rich in inorganic salts, gives rise to high levels of primary and secondary production. Fish growth rates are also high, but they vary with relatively small changes in the summer water temperature regime. Hence the survival of newly-hatched fish varies and this is shown up in later years by variations in year-class strengths. Anadromous salmonids show a distinct seasonality in their upstream spawning migration, and many fish do not migrate until after the end of the salmon angling season. However, river discharge influences migration and in years of very low discharge the seasonal patter can be disrupted. Little is known concerning species interactions, or of the effect of man-made adjustments to the river environment, on fish behavior and distribution patterns. Information on pike predation shows that apparently common-sense regimes of fishery management, designed to protect salmon populations, may be counterproductive. Traditional times for cutting aquatic macrophytes as a flood alleviation measure may be detrimental to the spawning success of roach. A switch to removing the weed in the autumn would have less impact on fish populations and is more cost-effective. Information derived from short-term investigations can be extremely informative, but results need to be set against a background of long-term investigations. (Author's abstract)
W89-12916

RIVER WILDLIFE DATABASES AND THEIR VALUE FOR SENSITIVE ENVIRONMENTAL MANAGEMENT.

Anglian Water Authority, Lincoln (England). Lincoln Div.
T. F. Coles, J. M. Southey, I. Forbes, and T. Clough.

Regulated Rivers Research and Management RRRMEP, Vol. 4, No. 2, p 179-189, 8 July 1989. 1 fig, 3 tab, 33 ref.

Descriptors: *Wildlife conservation, *Plant populations, *Birds, *River systems, *Wildlife management, *Bioindicators, *Species diversity, Wildlife habitats, Management planning, Environmental impact statement, Environmental policy, England, Surveys.

A survey over a three-year period, which commenced in 1987, of the plant and bird communities along 1200 kilometers of river in Lincolnshire and South Humberside, eastern England, is described. Analysis of data from 247 kilometers of river recorded a great diversity of wildlife, comprising 570 species of plants and 80 species of breeding birds. The management value of such surveys is discussed and these include the preparation of detailed maps of each 500-meter section of river, which illustrate the habitat structure, and plant and bird communities. A maintenance procedure for each 500-meter section of river is then agreed between conservation and operations personnel, preventing areas of wildlife importance from being accidentally destroyed. An index which combines both the diversity and rarity of the plant and bird communities is proposed as a measure of conservation importance. This index allows sections of river to be graded according to their conservation value into one of five groups. The surveys also enable predictions to be made of the effects of management actions on the wildlife and provide information by which fundamental reviews of operational activities can be carried out. (Author's abstract)
W89-12917

WATERWAYS BIRD SURVEY OF THE BRITISH TRUST FOR ORNITHOLOGY: AN OVERVIEW.

British Trust for Ornithology, Tring (England). Waterways Bird Survey.
S. P. Carter.

Regulated Rivers Research and Management RRRMEP, Vol. 4, No. 2, p 191-197, 8 July 1989. 3 fig, 1 tab, 19 ref.

Descriptors: *Water birds, *Inland waterways, *Riparian waters, *Wildlife conservation, Population density, Aquatic habitats, Canals, Dredging, Wildlife management, Environmental impact statement, England, Ireland, Surveys.

The background and methodology of the British Trust for Ornithology's Waterways Bird Survey is described. The scheme aims to produce breeding population indices for a range of riparian species based on survey work carried out annually at over 100 sites on waterways throughout Britain and Ireland. Habitat data are collected at each site which allow assessments to be made of factors affecting both the numbers and distribution of particular species. The effects of habitat changes can also be investigated. The scheme is illustrated with reference to population trends for coot and yellow wagtail. The results of habitat studies are discussed for moorhen. This shows that densities reach a maximum on canal sites, and that on sections of the River Ouzel, Bedfordshire and Grand Union Canal, Buckinghamshire, populations were adversely affected by dredging and regrading operations. (Author's abstract)
W89-12918

ASSESSMENT OF THE VALUE OF RIVERS FOR OTTERS.

Vincent Wildlife Trust, London (England).
E. Andrews.

Regulated Rivers Research and Management RRRMEP, Vol. 4, No. 2, p 199-202, 8 July 1989. 18 ref.

Descriptors: *Otters, *Wildlife conservation, *Environmental impact statement, *Wildlife management, *Animal populations, River systems, Water quality, Water pollution effects, Fish populations, Riparian vegetation, Trees, England, Wales.

The British otter requires good water quality, an adequate water supply of fish and certain types of vegetation or cavities (holts) adjacent to water bodies for resting and breeding sites. In the U.K. otters and their holts are legally protected. Trained surveyors are needed to confirm the presence of otters on a river as the animals are rarely seen, but their tracks and droppings (spraints) may be detected. To evaluate a river for possible otter habitation, information is required on water quality, fish species and biomass, as well as available habitat. Pioneer evaluation work based on the River Corridor Survey techniques has been done on Welsh rivers with good otter populations. Riparian vegetation, especially trees, is shown to be particularly important. This work is now being extended to areas on the margins of otter distribution such as the lower river Wye in England and Wales. Such surveys provide important management information for water authorities and give opportunities for enhancement work to benefit this animal. (Author's abstract)
W89-12919

CONSERVATION VALUE OF WATER SUPPLY RESERVOIRS.

Anglian Water Authority, Oundle (England). Oundle Div.
D. Moore, and A. Driver.

Regulated Rivers Research and Management RRRMEP, Vol. 4, No. 2, p 203-212, 8 July 1989. 6 tab, 18 ref, 1 append.

Descriptors: Water conveyance, *Reservoirs, *Wildlife conservation, *Wildlife management, *Aquatic life, Wetlands, Waterfowl, Amphibians, Agricultural engineering, Reservoir construction, Reservoir siting, Recreation wastes, England, Wales.

There are over 500 water supply reservoirs in England and Wales, a total water surface of 20,000 hectares, much of which has been flooded this century. Waterfowl, amphibious and aquatic wildlife have all benefited from this change, especially important after so much wetland has been drained and plowed to increase agricultural production. Modern reservoirs include landscape and conservation in their planning, construction and operation, often leading to their notification as Sites of Special Scientific Interest soon after their construction. Examples in the Anglian Water and Thames Water regions are discussed to demonstrate their value to wildlife as well as fulfilling their prime function for water supply. Pitsford Water (Northamptonshire), Rutland Water (Leicestershire), Staines Reservoir (Surrey), and Walthamstow Reservoirs (Greater London) show varying levels of conservation planning. Protection from recreational activity is shown to be an essential part of management at these sites. (Author's abstract)
W89-12920

WELSH RIVERS AND RESERVOIRS: MANAGEMENT FOR WILDLIFE CONSERVATION.
University Coll., Cardiff (Wales). School of Pure and Applied Biology.
For primary bibliographic entry see Field 5G.
W89-12921

SIMULATION OF BUBBLE PLUME DESTRATIFICATION SYSTEMS IN RESERVOIRS.
Western Australia Univ., Nedlands. Centre for Water Research.
For primary bibliographic entry see Field 5G.
W89-12922

INFLUENCE OF ENVIRONMENTAL FACTORS ON THE PHYTOPLANKTON SPRING BLOOM IN LAKE ZURICH.
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
W. Bleiker, and F. Schanz.
Aquatic Sciences, Vol. 51, No. 1, p 47-58, 1989. 3 fig, 1 tab, 34 ref.

Descriptors: *Lakes, *Phytoplankton, *Algal growth, Seasonal variation, Algae, Lake Zurich, Switzerland, Zooplankton, Irradiation, Mixing, Stratification, Nutrients, Flagellates, Diatoms, Biomass.

The development of the phytoplankton spring bloom in Lake Zurich in 1983 was investigated using frequent, short-term sampling. Four distinct growth periods were noted. During March 1-21 (high solar radiation, low wind) Stephanodiscus hantzschii and Rhodomonas made a considerable contribution to the total biomass. During March 28 to April 11 (high solar radiation, thermal stratification, strong wind) Asterionella formosa and Melosira granulata biomass increased steadily; Rhodomonas and Cryptomonas increased dramatically, total flagellates accounting for 59% of total biomass. During April 17-20 (high solar radiation, little wind, increased surface water temperature) flagellates increased, Asterionella formosa disappeared, and the populations of Melosira granulata, Fragilaria crotonensis, Fragilaria capucina, and Tabellaria fenestrata increased. During April 25-28 (high solar radiation, calm weather, thermal stratification, high surface water temperature) cell numbers of microalgae peaked, contributing 18% of the phytoplankton biomass; the last flagellate growth pulse of the spring bloom period occurred; and the populations of Fragilaria crotonensis and Melosira granulata increased. After April 29 the populations of flagellates and microalgae decreased rapidly. The populations of Fragilaria crotonensis and Melosira granulata did not collapse until May 5. Reasons for the phytoplankton population collapse were zooplankton grazing, nutrient limitation, and fungal attack. (Cassar-PTT)
W89-12924

FOOD AND FACTORS IN THE MORTALITY OF WHITEFISH LARVAE (COREGONUS SP.). EXAMPLE OF TWO LAKES OF DIFFERENT TROPHIC STATUS: LAKES SARNEN AND HALLWIL, CENTRAL SWITZERLAND (ALIMENTATION ET FACTEURS DE MORTALITE DES LARVES DE COREGONES) (COREGONUS SP.) EXEMPLE DE DEUX LACS DE NIVEAUX TROPHIQUES DIFFERENTS: LES LACS DE SARNEN ET DE HALLWIL (SUISSE CENTRALE).
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
D. Ponton, and R. Muller.
Aquatic Sciences, Vol. 51, No. 1, p 67-83, 1989. 9 fig, 1 tab, 29 ref. English summary.

Descriptors: *Trophic level, *Lakes, *Fish, *Larvae, Lake Sarnen, Lake Hallwil, Switzerland, Oligotrophic lakes, Water temperature, Temperature, Eutrophic lakes, Food habits, Whitefish.

The food of whitefish larvae was studied in 1987 in two pre-alpine lakes: oligotrophic Lake Sarnen and eutrophic Lake Hallwil, Switzerland. Sac fry were stocked in Lake Hallwil (March) and Lake Sarnen (early May) where the eggs were incubated at low temperature. Whitefish larvae and zooplankton at the same level were sampled regularly from March to June. The food spectra of the larvae in each lake were directly related to the available prey organisms. The whitefish larval catches in Lake Sarnen in 1987 dramatically decreased in comparison with 1986. Since the abundance and size of the principal zooplankton taxa were not significantly different in the two years, climatic factors, such as sudden cooling of the surface water, were proposed as the reason for the decrease. (Cassar-PTT)
W89-12925

INTRACELLULAR SOLUTES, PHOTOSYNTHESIS AND RESPIRATION OF THE GREEN ALGAE BLIDINGIA MINIMA IN RESPONSE TO SALINITY STRESS.
Bremen Univ. (Germany, F.R.). Fachbereich Chemie/Biologie.
For primary bibliographic entry see Field 2L.
W89-12926

EFFECTS OF WATER DEPTH ON TYPHA LATIFOLIA AND TYPHA DOMINGENSIS.
Louisiana State Univ., Baton Rouge. Dept. of Botany.
J. B. Grace.
American Journal of Botany AJBOAA, Vol. 76, No. 5, p 762-768, May 1989. 4 fig, 16 ref.

Descriptors: *Limnology, *Ponds, *Aquatic plants, *Water depth, *Cattails, Biomass, Plant morphology, Morphology, Plant growth.

The effects of water depth on morphology and biomass allocation of two species of cattails, Typha latifolia and Typha domingensis, were examined during three growing seasons. Water depths ranged from 5 cm above water to 115 cm below water. T. domingensis grew well at all depths while T. latifolia eventually died out at depths greater than 95 cm. The average final density for T. domingensis was about 120 shoots per sq m; for T. latifolia, less than 30 per sq m. Both species showed peak shoot densities at 22 cm depth with declines in densities with increasing depth. T. latifolia flowered only when grown 5 cm above the water, while T. domingensis flowered at all depths. For both species the incidence of flowering decreased with increasing water depth Both species showed increasing height with increasing depth with only slight differences between species in average height at any given depth. Average total biomass per ramet was substantially greater for T. latifolia (99.7 g) than for T. domingensis (46.2 g). T. latifolia plants growing above the water were less than half the overall average size. Beyond this, ramet size did not vary significantly with depth. For T. domingensis ramets increased progressively in size as water depth increased, with ramets in 115 cm of water weighing four times that of ramets in 5 cm. The differences between species in their overall allocation percentages for leaves, rhizomes, or roots were not significant. In T. domingensis general trends could not be detected for any plant part. However, T. latifolia showed a significant effect of water depth on allocation to leaves, with a strong progressive increase in allocation with increasing depth. T. latifolia also had increasing allocation to roots with increasing depth. (Cassar-PTT)
W89-12927

CONSIDERATION OF THE PROBLEMS OF SCALE IN THE STUDY OF THE ECOLOGY OF AQUATIC MACROPHYTES.
Wisconsin Univ.-Madison. Inst. for Environmental Studies.
A. M. Farmer, and M. S. Adams.
Aquatic Botany AQBODS, Vol. 33, No. 3-4, p 177-189, June 1989. 3 fig, 1 tab, 41 ref.

Descriptors: *Limnology, *Lakes, *Aquatic plants, *Macrophytes, *Submerged plants, Ecology, Hierarchy theory, Population dynamics, Plant populations, Model studies.

The ecology of submerged aquatic macrophytes is presented from a hierarchial perspective. The levels of study were individual plant (physiology), population, community, and ecosystem. The physiological ecology area considered how the physiology of plants (example, photosynthesis) varies with alterations in the external environment and the way in which changes in the environment are accommodated by reactions of the plant. Although it is difficult to extrapolate findings of individual plants to a plant community, it is helpful to use longer periods of observation, more demographic information, and optimality models. A typical problem with physiologic ecology is prediction of the distribution of species in a lake by indicating the constraints (spatial and temporal) that place a boundary on where a plant can grow without being able to predict abundance within the boundary region. Population ecology is concerned with population change, reproduction, comparative phenotypic fitness, and genetic variation, as well as seedling and vegetative propagule production and establishment. Studies of community ecology in a lake poses several problems. For example, two species may be negatively correlated over a small range, but positively correlated over a large area, which includes space where neither species occurs. Management of lakes usually takes place at the ecosystem level (harvesting plants, herbicide application, etc.). However, most understanding of the role of macrophytes comes from the lower levels of the hierarchy, and conclusions from one level cannot be extrapolated to other levels. Studies on the ecosystem level might involve major biomass studies, remote sensing, or model studies. (Cassar-PTT)
W89-12928

MACROPHYTE SUBMODEL FOR AQUATIC ECOSYSTEMS.
New York State Museum, Albany.
C. D. Collins, and J. H. Wlosinski.
Aquatic Botany AQBODS, Vol. 33, No. 3-4, p 191-206, June 1989. 6 fig, 1 tab, 71 ref.

Descriptors: *Limnology, *Lakes, *Aquatic plants, *Macrophytes, *Submerged plants, *Model studies, Ecology, Mathematical models, CE-QUAL-R1 model, Reservoirs, Photosynthesis, Respiration, Excretion, Mortality, Eau Galle Reservoir, Wisconsin.

A macrophyte submodel was incorporated and tested in CE-QUAL-R1, a one-dimensional, vertically averaged model of reservoir water quality. A quasi two-dimensional scheme was necessary to represent the spatial relationship of macrophytes in reservoirs adequately. The macrophyte processes modeled were photosynthesis, dark respiration, excretion, and nonpredatory mortality. Process equations for photosynthesis as a function of light and temperature, and dark respiration as a function of temperature were tested using data from laboratory studies. The submodel was field tested using data collected at Eau Galle Reservoir, Wisconsin. (Author's abstract)
W89-12929

DISTRIBUTION OF LITTORAL MACROPHYTES IN A NORTH SWEDISH RIVERSIDE LAGOON IN RELATION TO BOTTOM FREEZING.
Umea Univ. (Sweden). Dept. of Ecological Botany.
G. Renman.
Aquatic Botany AQBODS, Vol. 33, No. 3-4, p 243-256, June 1989. 9 fig, 1 tab, 31 ref.

Descriptors: *Limnology, *Rivers, *Ice, *Macrophytes, *Aquatic plants, Seasonal variation, Cold regions, Freezing, Aquatic habitats, Frost, Plant populations, Population dynamics, Habitats, Littoral zone, Abborravan, Sweden, River beds, Eleocharis acicularis, Subularia aquatica, Isoetes setacae.

The relationships between the distribution of aquatic macrophytes and the winter habitat conditions of the littoral zone in a river in northern Sweden were studied during a 6-year period. Bottom-freezing and sediment needle ice formation occurred as a result of gradual decreases in the water level. The vertical frequency patterns of Isoetes setacea Lam., Eleocharis acicularis (L.)

Roemer and Schultes, and Subularia aquatica L. approached normal distribution around an intermediate level of frost disturbance. The vertical movements of these and other species followed the annual changes in the extent of bottom freezing. Ranunculus reptans, an evergreen perennial with a stoloniferous growth habit, was particularly sensitive to freezing and frost heave, and it reacted by abortion of stolons and reduction of mass at the onset of the overwintering process. E. acicularis rhizomes were broken into pieces by frost, although the strong vegetative growth of this species caused each fragment to grow into a new plant in the spring. Other adaptive mechanisms included long deeply-buried roots or rhizomes, cold-resistant turions, and frost-resistant tubers. (Cassar-PTT)
W89-12931

GROWTH AND COMPETITION BETWEEN POTAMOGETON PECTINATUS L. AND MYRIOPHYLLUM EXALBESCENS FERN. IN EXPERIMENTAL ECOSYSTEMS.
Minnesota Univ., St. Paul. Dept. of Fisheries and Wildlife.
R. A. Moen, and Y. Cohen.
Aquatic Botany AQBODS, Vol. 33, No. 3-4, p 257-270, June 1989. 5 fig, 3 tab, 20 fig.

Descriptors: *Limnology, *Lakes, *Aquatic plants, *Macrophytes, Ecosystems, Submerged plants, Sago pondweed, Water milfoil, Biomass.

Two submerged aquatic macrophytes, Potamogeton pectinatus L. (sago pondweed) and Myriophyllum exalbescens Fern. (water milfoil) were grown in experimental aquaria in single-and mixed-species cultures in combinations of low and high densities. Biomass of individual plant parts (roots, shoots and tubers) was determined monthly for four months. P. pectinatus root and shoot biomass was greater than M. exalbescens root and shoot biomass throughout the experiment, at both low and high plant densities. From the relationships between plant densities and their biomass (in the presence and absence of conspecifics and individual plants of the other species), and under specific laboratory conditions, it was found that (1) intraspecific competition, as detected from the decrease in growth rate with increased plant density, was present; (2) M. exalbescens did not exert an interspecific competitive effect on P. pectinatus; (3) the interspecific competitive effect of P. pectinatus on M. exalbescens was stronger in inhibiting plant growth than that of M. exalbescens on itself; (4) increased plant density resulted in smaller P. pectinatus roots, shoots and tubers; (5) shoots of M. exalbescens, but not roots, were affected by increased plant density. (Author's abstract)
W89-12932

BIOMANIPULATION IN THE NETHERLANDS. APPLICATIONS IN FRESH-WATER ECOSYSTEMS AND ESTUARINE WATERS. AN INTRODUCTION.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
For primary bibliographic entry see Field 5G.
W89-12935

BIOMANIPULATION, NEW PERSPECTIVES FOR RESTORATION OF SHALLOW, EUTROPHIC LAKES IN THE NETHERLANDS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
For primary bibliographic entry see Field 5G.
W89-12936

CAUSES AND CONSEQUENCES OF THE SUCCESS OF BREAM IN DUTCH EUTROPHIC LAKES.
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 5C.
W89-12937

FOOD WEB MANIPULATION IN LAKE ZWEMLUST. POSITIVE AND NEGATIVE EFFECTS DURING THE FIRST TWO YEARS.
Water Board of Utrecht (Netherlands).
For primary bibliographic entry see Field 5G.
W89-12938

STRUCTURE AND FEEDING ACTIVITIES OF ZOOPLANKTON COMMUNITY IN LAKE ZWEMLUST IN THE TWO YEARS AFTER BIOMANIPULATION.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
For primary bibliographic entry see Field 5G.
W89-12939

RESTORATION BY BIOMANIPULATION OF LAKE BLEISWIJKSE ZOOM (THE NETHERLANDS). FIRST RESULTS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
For primary bibliographic entry see Field 5G.
W89-12940

NORTHERN PIKE (ESOX LUCIUS L.) AND AQUATIC VEGETATION, TOOLS IN THE MANAGEMENT OF FISHERIES AND WATER QUALITY IN SHALLOW WATERS.
Organization for the Improvement of Inland Fisheries, P.O. Box 433, 3430 AK Nieuwegein, The Netherlands.
For primary bibliographic entry see Field 5G.
W89-12941

GROWTH AND PRODUCTION OF 0+ BREAM (ABRAMIS BRAMA), 0+ ROACH (RUTILUS RUTILUS) AND 0+ CARP (CYPRINUS CARPIO) IN TEN DRAINABLE 0.1 HA PONDS.
Organization for Improvement of Inland Fisheries, P.O. Box 433, 3430 AK Nieuwegein, The Netherlands.
A. J. P. Raat.
Hydrobiological Bulletin HYBUD9, Vol. 23, No. 1, p 67-72, March 1989. 3 fig, 3 tab, 16 ref.

Descriptors: *Lakes, *Fish management, *Growth, *Ponds, Bream, Carp, Roach, Aquatic habitats, Habitats, Ecosystems, Phytoplankton, Cyprinids.

Ten drainable ponds (0.1 ha each, 25 x 40 m, average depth 1.1 m) were stocked with different combinations of bream, roach, and carp to study the impact of the fish on the aquatic community. The gross production of the fish communities, defined as the amount of organic matter produced by the fish during the period between stocking and draining, averaged 48.4 kg) and was dominated by carp (58.5%). A minimum estimate of the food consumption of the 0+ cyprinids was 760 kJ/sq m. The average production of bream and roach was much lower than that of carp due to a higher mortality and a more specialized feeding pattern. The gross productions of carp, bream, and roach in the ten ponds were not significantly related. (Cassar-PTT)
W89-12942

ALTERNATIVE STABLE STATES IN EUTROPHIC, SHALLOW FRESHWATER SYSTEMS. A MINIMAL MODEL.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
For primary bibliographic entry see Field 5G.
W89-12943

ACTIVE BIOLOGICAL SLUICE MANAGEMENT IN LAKE GREVELINGEN.
For primary bibliographic entry see Field 5G.
W89-12944

EFFECTS OF AQUATIC MACROPHYTES ON BENTHIC MACROINVERTEBRATES IN TWO FLORIDA LAKES.
Florida Univ., Gainesville. Dept. of Fisheries and Aquaculture.
H. L. Schramm, and K. J. Jirka.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 1, p 1-12, June 1989. 3 fig, 5 tab, 20 ref.

Descriptors: *Limnology, *Lakes, *Macrophytes, *Invertebrates, Vegetation, Aquatic plants, Orange Lake, Henderson Lake, Florida, Eutrophic lakes, Mesotrophic lakes, Benthos, Macroinvertebrates, Chaoborus, Panicum, Mollusks, Aquatic animals, Aquatic habitats, Habitats, Biomass, Insects, Population dynamics.

Greater numbers of invertebrate taxa were collected in vegetated than open water communities in two Florida lakes: Orange Lake (alkaline, soft water, eutrophic) and Henderson Lake, (alkaline, hard water mesotrophic). Differences in macroinvertebrate density and biomass were found among communities and sampling periods for most prevalent taxa in both lakes. In Henderson Lake the density of benthos was highest in the open water community due to the abundance of Chaoborus, and biomass of benthos was highest in the Panicum and open water communities due to the abundance of mollusks. In Orange Lake the density and biomass of benthos were higher in the vegetated than in the open water communities. Bottom substrate was an important determinant of benthic invertebrate abundance; density and biomass of benthos were greater in communities with firm substrata than in communities with soft organic substrata. When communities with similar substrata were compared, benthic invertebrates were more abundant in vegetated than in open water communities. (Cassar-PTT)
W89-12949

SIZE AND SPECIES COMPOSITION OF ZOOPLANKTON IN EXPERIMENTAL PONDS WITH AND WITHOUT FISHES.
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
P. A. Murtaugh.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 1, p 27-38, June 1989. 3 fig, 4 tab, 21 ref.

Descriptors: *Limnology, *Ponds, *Zooplankton, *Fish, *Predation, *Species composition, Population dynamics, Fish populations, Rotifers, Copepods, Invertebrates, Fish food, Aquatic habitats, Habitats.

Zooplankton communities were studied in ponds stocked with planktivorous fish (bluegill and pumpkinseed) and in ponds with no fish. The size and species composition of the zooplankton community were not statistically different in both types of ponds. However, when rotifers and copepod nauplii were excluded from the analyses, the small-bodied forms, especially Bosmina longirostris, were preponderant in the fish-containing ponds. (Cassar-PTT)
W89-12951

NUTRIENT ENRICHMENT AND PRIMARY PRODUCTIVITY IN BANJARA LAKE, HYDERABAD, INDIA. COMPARISON OF FILTRATION AND ACIDIFICATION BUBBLING METHODS.
Hyderabad Univ. (India). School of Life Sciences.
G. N. Reddy, and M. N. V. Prasad.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 1, p 39-43, June 1989. 1 tab, 17 ref.

Descriptors: *Limnology, *Lakes, *Nutrients, *Primary productivity, Productivity, Banjara Lake, India, Filtration technique, Acidification bubbling method, Nitrates, Ammonia, Phosphorus, Organic matter.

Primary productivity was measured as C14 uptake by the filtration technique and the acidification bubbling method in Lake Banjara water, enriched with nitrate (1 or 2 mg/liter), ammonia (100 or 250 microgram/liter), and/or phosphorus (500 microgram/liter) in 14 combinations. Levels of primary productivity obtained from the acidification bubbling method were higher (14.0 +or-5%) than those obtained with the filtration technique. Since dissolved organic matter was only 0.036 mg/cu m/hr, the difference was not related to excretion. Enrichment with 1 mg/liter nitrate enhanced productivity slightly, but 2 mg/liter nitrate decreased productivity by 7.37%. Enrichment with nitrate,

ammonia, and phosphorus also decreased productivity. Enrichment with nitrate (1 mg/liter) plus ammonia (250 microgram/liter) caused the maximum increase in C14 uptake as measured by both techniques (22.4% for filtration technique and 24.7% for the acidification method). (Cassar-PTT)
W89-12952

THERMAL TOLERANCES OF COMMON CLADOCERA.
North Carolina Univ., Morehead City. Inst. of Marine Sciences.
M. A. Mallin, and W. E. Partin.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 1, p 45-50, June 1989. 1 fig, 1 tab, 19 ref.

Descriptors: *Water pollution effects, *Water temperature, *Invertebrates, *Thermal pollution, Temperature, Waterfleas, Mortality, Daphnia, Seasonal variation, Lakes.

Thermal tolerances and fecundity over seven days at temperatures from 20 to 35 C were determined for Daphnia ambigua, Daphnia parvula, and Ceriodaphnia reticulata. Daphnia ambigua and D. parvula showed good survival at 30 C, but total mortality occurred within six days at 32 C for D. ambigua and at 33 C for D. parvula. Total mortality occurred within five days at 35 C for C. reticulata. Highest fecundity for all three species occurred at 25 C, followed by 30 C. Fecundity was reduced for all three test species above 30 C and was reduced for D. ambigua and D. parvula below 25 C. (Author's abstract)
W89-12953

SEASONAL REPRODUCTIVE DEVELOPMENT OF LAMPSILIS CARDIUM, AMBLEMA PLICATA PLICATA, AND POTAMILUS ALATUS (PELECYPODA: UNIONIDAE) IN THE UPPER MISSISSIPPI RIVER.
National Fisheries Research Center, La Crosse, WI.
L. E. Holland-Bartels, and T. W. Kammer.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 1, p 87-92, June 1989. 1 fig, 22 ref.

Descriptors: *Rivers, *Shellfish, *Water temperature, Temperature, Mussels, Aquatic habitats, Habitats, Reproduction, Seasonal variation, Mississippi River, Lampsilis cardium, Amblema plicata, Potamilus alatus.

Adult specimens of three species of freshwater mussels common to the upper Mississippi River were examined histologically to determine seasonal patterns of development in gametogenesis and release of glochidia. Full maturation of gonadal materials in Lampsilis cardium (formerly L. ovata ventricosa), a long-term breeder, occurred when ambient river temperatures reached 24 to 26 C, between late July and early August. By mid-August glochidia were present in the marsupia. Glochidia were released from late May through mid-June of the following year once water temperatures reached 20 C. The long-term breeder Potamilus alatus demonstrated full gonadal maturation earlier than seen in L. cardium with reproduction completed by late July (26 C). Glochidia of P. alatus were released over a period similar to that observed for L. cardium, late May through early July of the following year. Fully mature Amblema plicata plicata, a short-term breeder, were collected from late May through early July (18 to 21 C). Glochidia were released from early June to early August of the same year. (Author's abstract)
W89-12955

USE OF NICHE BREADTH AND PROPORTIONAL SIMILARITY IN FEEDING TO STIPULATE RESOURCE UTILIZATION STRATEGIES IN FISH.
Herbert H. Lehman Coll., Bronx, NY. Dept. of Biological Sciences.
J. W. Rachlin, B. E. Warkentine, and A. Pappantoniou.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 1, p 103-112, June 1989. 1 tab, 31 ref. BHE-PSC-CUNY 666311 and 668201.

Descriptors: *Limnology, *Data collections, *Fish, *Foods, Fish food, Fish diets, Niche breadth, Proportional similarity, Levins index, Algorithms.

A hypothetical data set was evaluated using algorithms to calculate niche breadth (Levins' index) and the proportional similarity in feeding between the species of interest and the resource base (the PS ratio of Feinsinger, et al). The results were then examined for the occurrence of concordance and non-concordance between information generated by these two algorithms. The nature of the concordance and non-concordance can be used to define strategies of resource utilization. That is, if the concordance results from both a high niche breadth value and a high proportional similarity in feeding, the foraging strategy is that of a classic generalist. If the values for proportional similarity in feeding and the niche breadth are both low, the foraging strategy is that of a classic specialist. In case of non-concordance where the value for niche breadth is high but the value for proportional feeding is low, the foraging strategy is that of a selectionist. But if the niche breadth value is low and the proportional similarity in feeding is high, then the strategy is that of an opportunist. These definitions allow for the avoidance of the so called paradox of niche breadth. When applied to measurements derived from an empirical data set, these definitions were helpful in ordering the 12 species of the community by resource utilization strategy. Five of the species were specialists; three of the species were opportunists. The remaining four species exhibited feeding strategies which placed them on the resource utilization continuum between specialists and opportunists. No species was functioning as either a classic generalist or as a selectionist. (Author's abstract)
W89-12956

FACTORS INFLUENCING THE ABUNDANCE OF BROOK TROUT (SALVELINUS FONTINALIS) IN FORESTED MOUNTAIN STREAMS.
Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie.
S. J. Kozel, and W. A. Hubert.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 1, p 113-122, June 1989. 1 fig, 3 tab, 24 ref.

Descriptors: *Streams, *Fish, Trout, Brook trout, Brown trout, Forest watersheds, Medicine Bow National Forest, Wyoming, Stream order, Mountains, Population density, Aquatic habitats, Habitats.

Physical and biological factors that appear to influence standing stocks (kg/ha) of brook trout (Salvelinus fontinalis) were identified in the Medicine Bow National Forest, Wyoming, for 32 forested reaches of mountain streams in drainages unaltered by human activity. Brook trout abundance declined as stream size increased. This decline appeared to be related to at least two factors: decline in habitat quality with increasing stream size and interaction with brown trout (Salmo trutta) at lower elevations. The greatest variation in brook trout abundance was accounted for by drainage basin area and elevation of the stream reach. (Author's abstract)
W89-12957

FACTORS DETERMINING THE NUTRITIVE STATUS AND PRODUCTION OF ZOOPLANKTON IN A HUMIC LAKE.
Oslo Univ. (Norway). Dept. of Biology.
D. O. Hessen.
Journal of Plankton Research JPLRD9, Vol. 11, No. 4, p 649-664, July 1989. 7 fig, 4 tab, 31 ref.

Descriptors: *Limnology, *Lakes, *Zooplankton, *Nutrient requirements, Invertebrates, Humic acids, Nitrogen, Particulate matter, Bacteria, Organic matter, Aquatic habitats, Habitats, Seasonal variation, Foods, Daphnia, Biomass, Lake Kjelsasputten, Norway.

Zooplankton egg production and nutritional status as related to environmental factors were studied in a humic lake. Both parameters exhibited a pronounced spring peak, a mid-summer depression and a second, smaller autumnal peak. The overall macrozooplankton community apparently suffered from severe food limitation, particularly with regard to food quality, during the study period. This limitation was confirmed with length/carbon regressions of well-fed and starved laboratory individuals of Daphnia. Body carbon in the lake animals corresponded to that of laboratory-raised starved individuals. Regression analysis indicated that bacteria particulate organic carbon and particulate nitrogen best explained changes in egg production, while algal biomass was of negligible importance for all species. For Daphnia, size-specific carbon content (length/carbon regressions) and C/N ratios were computed for all sampling dates. Both simple and multiple regression analysis confirmed that bacteria, particulate organic carbon and particulate nitrogen gave the major positive contribution to variance in size-specific C content, whereas total zooplankton biomass was the main negative contributor to the same parameters. (Cassar-PTT)
W89-12958

DIURNAL VERTICAL AND SEASONAL HORIZONTAL DISTRIBUTION PATTERNS OF MYSIS RELICTA IN A LARGE NORWEGIAN LAKE.
Direktoratet for Vilt og Ferskvannsfisk, Trondheim (Norway).
V. Moen, and A. Langeland.
Journal of Plankton Research JPLRD9, Vol. 11, No. 4, p 729-745, July 1989. 9 fig, 3 tab, 45 ref.

Descriptors: *Limnology, *Lakes, *Fish, *Zooplankton, *Predation, *Foods, Seasonal variation, Lake Snasavatnet, Norway, Mysis relicta, Diurnal distribution, Benthos.

Mysis relicta was sampled intensively along a depth profile in Lake Snasavatnet, Norway, using benthic trawls and vertical net hauls. Samples were made around 12 and 24 hours in May, June, August, and September 1984. The light regime and temperature were also recorded. Mysis relicta showed a size-dependent diurnal vertical migration and seasonal benthic horizontal migration between shallow and deep areas. The young individuals left the marsupium in spring while the adults were staying in the benthos in shallow areas. As they grew in size, the young individuals changed habitat, migrating into the pelagic zone and the deeper benthic areas. Mysis showed a bimodal vertical distribution pattern at the deepwater station, with one density peak in the water column and another along the bottom both day and night between May and September. Only individuals in the upper density peak at the deep station seemed able to sense light and were therefore able to synchronize their vertical migration with the light cycle. Other factors than light seemed necessary to trigger the upward migration from the bottom: possibly degree of hunger or satiation and a lack of zeitgeber for vertically migrating individuals. The density of Mysis was low in the pelagic zone compared to the shallow benthic area throughout the sampling period. Together with the difference in distribution pattern in the pelagic and benthic zones, this may influence the distribution pattern of salmonids which seek Mysis as a food item in Lake Snasavatnet. (Cassar-PTT)
W89-12959

RESPONSE OF GONYAULAX TAMARENSIS TO THE PRESENCE OF A PYCNOCLINE IN AN ARTIFICIAL WATER COLUMN.
Danmarks Fiskeri- og Havundersoegelser, Charlottenlund.
J. Rasmussen, and K. Richardson.
Journal of Plankton Research JPLRD9, Vol. 11, No. 4, p 747-762, July 1989. 7 fig, 1 tab, 29 ref.

Descriptors: *Limnology, *Lakes, *Phytoplankton, *Stratification, Dinoflagellates, Gonyaulax tamarensis, Pycnocline, Marine algae, Salinity, Interfaces, Saline-freshwater interfaces, Aquatic habitats, Habitats.

The swimming behavior of the dinoflagellate Gonyaulax tamarensis when exposed to varying degrees of stratification in an experimental water

column was examined. When the organisms were presented with a halocline with salinity gradients of <7 o/oo occurring over a few centimeters, they crossed the salinity barrier and accumulated at the highest available photon flux density (100 micromol/sq m/sec). Cells exposed to a gradient of >7 o/oo remained at the halocline. However, when light above the pycnocline was attenuated by the addition of food color, the cells crossed a halocline with a gradient of 10 o/oo and accumulated at the highest available photon flux density. In the absence of added nutrients (inorganic N and P), the organisms did not show a phototactic response. The organisms did not show a marked diel migration pattern. (Cassar-PTT)
W89-12960

PHYTOPLANKTON DISTRIBUTION IN A TEMPERATURE FLOODPLAIN LAKE AND RIVER SYSTEM. I. HYDROLOGY, NUTRIENT SOURCES AND PHYTOPLANKTON BIOMASS.
University of East Anglia, Norwich (England). School of Environmental Sciences.
B. Moss, I. Booker, H. Balls, and K. Manson.
Journal of Plankton Research JPLRD9, Vol. 11, No. 4, p 813-838, July 1989. 17 fig, 4 tab, 33 ref.

Descriptors: *Limnology, *Rivers, *Lakes, *Phytoplankton, *Nutrients, Hydrology, Flood plains, Bure River, Broads system, United Kingdom, Phosphorus, Nitrogen, Chlorophyll, Eutrophic lakes, Saline lakes, Mixing, Seasonal variation, Algae.

A flood plain system of streams, a main river (Bure) and 10 man-made lakes (Broads) was investigated. Retention times of water in this tidal, hypertrophic system varied from <1 day to >8 weeks in different parts of the system. There was no correlation between measured retention time and mean phytoplankton chlorophyll a concentration, probably a result of incomplete mixing. Water was retained in parts of the Broads far longer than the average retention time, so that algal crops built up. This also reduced the seasonal variability in size of standing crop, which was also uncorrelated with retention time. The mean growing-season chlorophyll a concentration and total phosphorus concentration had a very close linear relationship, suggesting that crop levels are set by phosphorus availability. N:P ratios in incoming water were very high. Much phosphorus was apparently lost to the sediments, but internal loading of phosphorus from the sediment was important in only one area, South Walsham Broad. (See also W89-12963) (Cassar-PTT)
W89-12962

PHYTOPLANKTON DISTRIBUTION IN A FLOODPLAIN LAKE AND RIVER SYSTEM. II. SEASONAL CHANGES IN THE PHYTOPLANKTON COMMUNITIES AND THEIR CONTROL BY HYDROLOGY AND NUTRIENT AVAILABILITY.
University of East Anglia, Norwich (England). School of Environmental Sciences.
B. Moss, and H. Balls.
Journal of Plankton Research JPLRD9, Vol. 11, No. 4, p 839-867, July 1989. 15 fig, 2 tab, 35 ref.

Descriptors: *Limnology, *Rivers, *Lakes, *Phytoplankton, *Nutrients, Hydrology, Flood plains, Bure River, Broads system, United Kingdom, Phosphorus, Nitrogen, Eutrophic lakes, Saline lakes, Seasonal variation, Algae.

Phytoplankton community development and water chemistry were studied for 2 years in the lowland River Bure and most of the Broads (shallow lakes) associated with it. The data were analyzed in terms of time for development, which is the minimum estimated time that an average parcel of water takes to reach a site plus the time it spends there before it moves downstream. Regressions of mean chlorophyll a on time for development were linear and suggested that the upstream Broads, where phytoplankton first develops in quantity in the system, have retained the water for longer than anticipated from hydrological measurements. They effectively added several weeks to the time for development. Available phosphate and nitrate concentrations decreased with time for development. Those for silicate increased. Seasonal changes in the upper part of the study area were largely in centric diatom species. Pennate diatoms and cyanophytes became predominant in the lower stretches. All major species were present at the extreme upper end of the stretch. With increasing development time, in a water mass dominated by water entering at the head of the study area, a succession of Cyclotella meneghiniana, Stephanodiscus hantzshii and Melosira sp. was followed by Oscillatoria sp., then Diatoma elongatum, Synedra ulna and Anabaena planctonica. Eighty other taxa were also present. (See also W89-12962) (Cassar-PTT)
W89-12963

DETECTION OF EXOGENOUS GENE SEQUENCES IN DISSOLVED DNA FROM AQUATIC ENVIRONMENTS.
University of South Florida, St. Petersburg. Dept. of Marine Science.
For primary bibliographic entry see Field 7B.
W89-12964

SUCCESSION OF ALGAL FLORA IN DEEP WATER RICE FIELD OF SONARGAON, BANGLADESH.
Dacca Univ. (Bangladesh). Dept. of Botany.
Z. N. T. Begum, R. Mandal, and A. R. Paul.
Phykos PHKSBF, Vol. 27, No. 1-2, p 15-24, 1988. 5 tab, 15 ref.

Descriptors: *Ponds, *Rice, *Agriculture, *Algae, Sonargaon, Bangladesh, Water quality, Nutrients, Soil properties, Dissolved oxygen, Hydrogen ion concentration, Alkalinity, Carbon dioxide, Cyanophyta.

Water chemistry and soil fertility significantly affected the growth of algal populations in flooded rice field ecosystems. Conductivity was 41 to 62 mg/liter; total alkalinity, 25 to 42 mg/liter; dissolved oxygen, 5.6 to 8.8 mg/liter; pH, 5.2 to 7.2. Free carbon dioxide content was 20 to 42 mg/liter from the middle of July to the first week of August, thereafter it dropped to 6 mg/liter and remained mostly unchanged until October. Algal growth increased by about 4.5 times during the flooded period as compared to pre-flood and post-flood stages. During pre-flooding, 9 genera of algae (dominant, Pinnularia) were found. After flooding the same genera were present, with the addition of Cosmarium. During flooding 17 types of algae were recorded. The most abundant were Coleochaete, Oedogonium, Cosmarium, Fragilaria, Navicula, Pinnularia, Anabaena, and Gloeotrichia. Algal abundance varied greatly from place to place and, to a lesser extent, with time. Greatest abundance was just before flooding and after transplanting. Most of the algal genera did not show any relationship with total N and P content of the soils. Only Nostoc, Spirogyra, and Navicula showed a significant relationship with N, and Gloeotrichia and Pinnularia with P. Water pH significantly affected the growth of Coleochaete, Oedogonium and Cosmarium. (Cassar-PTT)
W89-12966

STUDIES ON ALGAE OF POLLUTED PONDS OF KANPUR (INDIA). VIII. ROLE OF BLUE GREEN ALGAE.
D.A.V. Coll., Muzaffarnagar (India). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W89-12967

SEASONAL CHANGES IN PHYTOPLANKTON COMMUNITIES IN A FRESH WATER POND AT DHARWAR, KARNATAK STATE, INDIA.
Mysore Univ. (India). Dept. of Botany.
S. P. Hosmani.
Phykos PHKSBF, Vol. 27, No. 1-2, p 82-87, 1988. 2 tab, 16 ref.

Descriptors: *Limnology, *Ponds, *Phytoplankton, *Population dynamics, Dharwar, India, Algae, Water quality, Eutrophication, Seasonal variation.

Water quality and phytoplankton populations were studied in Railway Gate Pond, Dharwar, India, at intervals during 1972-1974 and 1978-1980. This pond receives water from homes and in monsoon season is 4 m deep. It has no outlet and no tree cover. The water is constantly agitated by cattle and by persons doing laundry. It also serves as a fish farm. During 1972-1974 about 10 species of Chlorcoccales and 14 species of Euglenophyceae were found. In the 1978-1980 survey only one of Chlorococcales group ocurred in small numbers; Euglena elastica, E. elongata, and Trachelmononas charkoweinis were reported in abundance. Changes in water quality between the two surveys were increases in pH, nitrates, bicarbonates, calcium, total solids, and potassium; and decrease in carbon dioxide, ammonia, and oxidizable organic matter. (Cassar-PTT)
W89-12969

LAKE ACIDIFICATION STUDIES: THE ROLE OF INPUT UNCERTAINTY IN LONG-TERM PREDICTIONS.
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5C.
W89-12978

EXPORT OF DISSOLVED ORGANIC CARBON AND ACIDITY FROM PEATLANDS.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
N. R. Urban, S. E. Bayley, and S. J. Eisenreich.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1619-1628, July 1989. 4 fig, 4 tab, 91 ref.
NSF grant DEB7922142.

Descriptors: *Limnology, *Water pollution sources, *Peat bogs, *Lakes, *Dissolved solids, *Acidic water, Organic carbon, Fens, Bogs, Seasonal variation, Hydrogen ion concentration.

Because of the vast areal extent and high rates of organic matter production of peatlands, such ecosystem have a significant but poorly quantified impact on large numbers of lakes. The exports of dissolved organic carbon (DOC) and acidity from two bogs, one in Minnesota and one in Ontario, and a poor fen in Minnesota. Rates of export of DOC were high for all three peatlands (8-40 g/sq m/yr), and variations were largely dependent on water yield. Dissolved organic matter from all sites exhibited a charge density between 7 and 24 microeq/mg DOC, and rates of acidity export from all three sites were similar (100-200 meq/sq m/yr). Variation in elemental composition of dissolved organic matter suggests a seasonal change in relative proportions of organic matter fractions and indicates direct incorporation of microbially reduced sulfur into organic matter. Current definitions and measurement techniques for alkalinity are inappropriate for such high DOC waters, and fixed end point titration to pH 4 is suggested as an alternative. (Author's abstract)
W89-12988

COLONIZATION OF EXPERIMENTALLY DISTURBED PATCHES BY STREAM MACROINVERTEBRATES IN THE ACHERON RIVER, VICTORIA.
Monash Univ., Clayton (Australia). Dept. of Zoology.
T. J. Doeg, P. S. Lake, and R. Marchant.
Australian Journal of Ecology AJECDQ, Vol. 14, No. 2, p 207-220, June 1989. 6 fig, 6 tab, 50 ref.
Australian Water Research Advisory Council Grant No. 85/3.

Descriptors: *Streams, *Macroinvertebrates, *Benthic fauna, *Colonization, *Population density, *Species composition, Physical disturbances, Seasonal variation, Acheron River, Victoria, Australia.

Twenty-five patches (1 sq m) of natural stream substratum in the Acheron River, Victoria, Australia were physically disturbed by kicking and raking during winter 1986 and summer 1987. The macroinvertebrate composition of these disturbed

patches was examined at various times over the following 71 days, and compared with adjacent undisturbed control patches sampled concurrently. The disturbance did not alter the particle-size distribution (>150 microns) of the disturbed patches. Organic material was reduced in the disturbed patches by about 70% in each season, but returned to control levels within 21 days in winter and 8 days in summer. The total number of species, and the density of species and individuals were all significantly reduced by the disturbance. Recovery of species density was complete after 21 days during winter and 8 days during summer, and the density of individuals recovered after 71 days during winter and 8 days in summer. The differences were due to the slower colonization rate of Chironomidae in winter, either because of a lower drift rate, or a slower recovery of detritus in winter. In each season, the species remaining immediately following the disturbance, and those subsequently colonizing the disturbed patches, were in the same rank order (Spearman Rank correlation) as their occurrence in the control patches, suggesting that no taxa were differentially affected by the treatment. No evidence was found to allow the application of the Intermediate Disturbance Hypothesis to explain species diversity at the scale of this study. It appears that current hypotheses developed to explain the relationship between diversity and disturbance in sessile communities do not apply to highly mobile communities in streams. (Author's abstract)
W89-13004

SIMPLIFIED METHOD FOR WETLAND HABITAT ASSESSMENT.
Kansas State Univ., Manhattan. Dept. of Forestry.
T. T. Cable, V. Brack, and V. R. Holmes.
Environmental Management EMNGDC, Vol. 13, No. 2, p 207-213, March-April 1989. 2 tab, 19 ref.

Descriptors: *Wetlands, *Wildlife habitats, *Habitat assessment, *Birds, *Species diversity.

A wetland habitat assessment technique (HAT) uses birds as indicators of habitat quality. The technique is quick, simple, inexpensive and lends itself to screening large numbers of wetlands. HAT can provide input to more extensive evaluation techniques. Measures of species diversity and rarity are used to assess the quality of the wetlands. The presence of more species and uncommon species makes an area more valuable. By applying the notion of ecologically optimum size, the technique addresses the issue of economic efficiency. Results of field testing HAT on 11 tidally influenced wetlands in Delaware (two forested palustrine, six emergent estuarine, and three with significant proportions of both types) illustrate HAT's utility. (Sand-PTT)
W89-13014

ECOLOGICAL ANALYSIS OF DISTURBED RIVERBANKS IN THE MONTREAL AREA OF QUEBEC.
Montreal Univ. (Quebec). Inst. Botanique.
E. Morin, A. Bouchard, and P. Jutras.
Environmental Management EMNGDC, Vol. 13, No. 2, p 215-225, March-April 1989. 6 fig, 1 tab, 24 ref.

Descriptors: *Revegetation, *Stream banks, *Riverbank habitats, *Plant populations, *Species composition, *Soil types, Statistical analysis, Cluster analysis, Principle coordinate analysis, Abiotic components, Montreal.

In revegetation trials on disturbed riverbank sites in the Montreal region (Quebec, Canada), an analysis of their structure by means of their biotic and abiotic components was undertaken. Vegetation sampling and physical surveys, together with soil analyses of 62 stands, grouped in 20 sectors, were carried out in the summer of 1986. The statistical analyses of biotic and abiotic data were executed in parallel by a hierarchical agglomerative cluster analysis (arithmetic average clustering) and by an ordination in reduced space (principal coordinate analysis). The species colonizing these riverbanks are, for the most part, ruderals from the Montreal region, of which more than 50% are introduced species. The pioneering communities characterizing these artificial habitats have had very little impact on the physical conditions of their environment; therefore, the ordination on the plant communities proves to be strongly correlated to the ordination stemming from the abiotic components. The statistical analysis retains the original sectors, underlying the fact that each human intervention generally results in the creation of a particular ecological situation. (Author's abstract)
W89-13015

CHANGES IN LAKE ECOSYSTEMS CONNECTED WITH THE POWER-GENERATING INDUSTRY (THE OUTLINE OF PROBLEM): THE KONIN LAKES (POLAND) AS THE STUDY SITES.
Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W89-13084

MAIN CHANGES IN THE KONIN LAKE SYSTEM (POLAND) UNDER THE EFFECT OF HEATED-WATER DISCHARGE POLLUTION AND FISHERY.
Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W89-13085

LONG-TERM VARIATION IN HABITAT AND TROPHIC FACTORS IN THE KONIN LAKES (POLAND) UNDER THE INFLUENCE OF HEATED-WATER DISCHARGE AND POLLUTION.
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 5C.
W89-13086

LONG-TERM AND SEASONAL CHANGES IN THE PRIMARY PRODUCTION AND DESTRUCTION IN HEATED LAKES NEAR KONIN (POLAND).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 5C.
W89-13087

CHANGES IN THE COMPOSITION AND QUANTITATIVE RELATIONS OF THE PHYTOPLANKTON IN HEATED LAKES NEAR KONIN (POLAND).
Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W89-13088

LONG-TERM CHANGES IN THE COMPOSITION, PRODUCTIVITY AND TROPHIC EFFICIENCY IN THE ZOOPLANKTON COMMUNITY OF HEATED LAKES NEAR KONIN (POLAND).
Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W89-13089

EFFECT OF HEATED-WATER DISCHARGE IN THE KONIN LAKES (POLAND) ON THEIR ICHTHYOFAUNA.
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Dept. of Ichthyology.
For primary bibliographic entry see Field 5C.
W89-13090

SPATIAL PATTERN OF TEMPERATURE, OXYGEN AND NUTRIENT CONCENTRATION IN TWO LAKES OF DIFFERENT HEATED-WATER DISCHARGE SYSTEMS.
Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W89-13091

SPATIAL DISTRIBUTION OF THE PHYTOPLANKTON IN TWO LAKES IN RELATION TO THE THROUGH-FLOW OF HEATED WATERS.
Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W89-13092

SPATIAL DISTRIBUTION OF THE ZOOPLANKTON AND ITS POPULATION FEATURES IN TWO LAKES OF DIFFERENT HEATED-WATER THROUGH-FLOW.
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 5C.
W89-13093

ZOOPLANKTON LOSSES DURING THE PASSING THROUGH THE COOLING SYSTEM OF A POWER STATION.
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 5C.
W89-13094

DISTURBANCES IN ZOOPLANKTON SEASONALITY IN LAKE GOSLAWSKIE (POLAND) AFFECTED BY PERMANENT HEATING AND HEAVY FISH STOCKING.
Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
For primary bibliographic entry see Field 5C.
W89-13095

ABUNDANCE AND DISTRIBUTION OF THE MUSSEL DREISSENA POLYMORPHA (PALL.) IN HEATED LAKES NEAR KONIN (POLAND).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 5C.
W89-13096

EFFECT OF THE INTRODUCTION OF HERBIVOROUS FISH IN THE HEATED LAKE GOSLAWSKIE (POLAND) ON THE FRY OF LOCAL ICHTHYOFAUNA.
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Dept. of Ichthyology.
For primary bibliographic entry see Field 5C.
W89-13097

EVALUATION OF THE CIC MODEL OF 210PB DATING OF SEDIMENTS.
McMaster Univ., Hamilton (Ontario). Dept. of Materials Science and Engineering.
For primary bibliographic entry see Field 7B.
W89-13116

MANAGEMENT OF PHOSPHORUS AND NITROGEN INPUTS TO LAKE ROTORUA, NEW ZEALAND.
Department of Scientific and Industrial Research, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 5G.
W89-13124

MODELING THERMAL STRATIFICATION IN TRANSPARENT ADIRONDACK LAKE.
Engineering-Science, Fairfax, VA.
D. A. Rice, T.-K. Tsay, S. W. Effler, and C. T. Driscoll.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 4, p 440-456, July 1989. 7 fig, 1 tab, 29 ref.

Descriptors: *New York, *Mountain lakes, *Acid lakes, *Acid rain effects, *Acidic water, *Transparency, *Thermal stratification, Limnology, Woods Lake, Optical properties, Mathematical models, Prediction, Performance evaluation, Temperature, Hypolimnion, Acid rain, Light penetration.

A mixed-layer thermal stratification model was calibrated for Woods Lake, a shallow, acidic, transparent lake located in the Adirondack region of New York, for most of ice-free period of 1985. The model also was used to simulate the stratification regime of the lake for the following year, in which environmental conditions were similar to 1985. For both years, the model adequately depicted those stratification features previously identified as sensitive to acidification-induced increase in transparency, including the thickness of the hypolimnion, the temperature of the hypolimnion, and the duration of stratification. Thus, the model may facilitate assessments of the impact of acidification on the thermal characteristics of lakes. Model sensitivity analyses indicate that shallow lakes lose continuous summer stratification if they experience the increases in light penetration reportedly associated with acidification. Further, accurate specification of light attenuation coefficients and lake bathymetry were critical to the effective application of a stratification model to transparent shallow lakes. (Author's abstract)
W89-13125

PHYSICO-CHEMICAL INTERACTIONS AND BIOCONCENTRATION OF ZINC AND LEAD IN THE INDUSTRIALLY POLLUTED HUSAINSAGAR LAKE, HYDERABAD, INDIA.
Osmania Univ., Hyderabad (India). Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W89-13154

CAESIUM-137 IN PERCH IN SWEDISH LAKES AFTER CHERNOBYL--PRESENT SITUATION, RELATIONSHIPS AND TRENDS.
Uppsala Univ. (Sweden). Dept. of Hydrology.
For primary bibliographic entry see Field 5B.
W89-13155

EFFECTS OF NUTRIENTS ON THE SURVIVAL OF ESCHERICHIA COLI IN LAKE WATER.
Warwick Univ., Coventry (England). Dept. of Biological Sciences.
C.-H. Lim, and K. P. Flint.
Journal of Applied Bacteriology JABAA4, Vol. 66, No. 6, p 559-569, June 1989. 6 fig, 2 tab, 20 ref.

Descriptors: *Limiting nutrients, *Path of pollutants, *Limnology, *Escherichia coli, *Aquatic habitats, *Adaptation, *Lakes, Survival, Nutrients, Microorganisms, Physical properties, Chemical properties, Biological properties, Survival, Enteric bacteria, Public health, Microbiological studies, Wastewater, Phosphates, Carbon, Ammonium compounds, Amino acids, Nitrogen.

The survival of a microorganism in an environment in which it is not indigenous is dependent upon its ability to withstand physical, chemical, and biological conditions which are different from those encountered in its natural habitat. Knowledge of the survival characteristics of enteric bacteria in a variety of aquatic environments is of prime importance to the public health microbiologist as these bacteria are used as indicators of fecal water pollution. Escherichia coli was shown to survive without decline in viable counts for at least 12 days in filtered autoclaved lake water. In unfiltered lake water there was a rapid decline in the viable count of E. coli. The addition of synthetic sewage to filtered autoclaved lake water led to an increase in the viable count of E. coli and to an increase in the survival time in unfiltered water. The addition of phosphate and carbon sources did not significantly increase the survival time in unfiltered water over the controls. The addition of ammonium sulfate and some amino acids as nitrogen sources to the unfiltered water did lead to an increase in the survival times for the E. coli and this increase was proportional to the concentration of the added nitrogen source. (Author's abstract)
W89-13159

EVALUATION OF THE MEASUREMENTS OF EXTRACELLULAR ENZYME ACTIVITIES IN A POLYHUMIC LAKE BY MEANS OF STUDIES WITH 4-METHYUMBELLIFERYL-SUBSTRATES.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie.
U. Muenster, P. Einio, and J. Nurminen.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 3, p 321-337, May 1989. 16 fig, 2 tab, 34 ref.

Descriptors: *Humic acids, *Eutrophic lakes, *Limnology, *Enzymes, *Fluorescence, Organic carbon, Hydrogen ion concentration, Laboratory equipment, Lake Mekkojarvi, Finland.

The validity of 4-methylumbelliferyl-substrates (MUFS) and 4-methyl-umbelliferone (MUF) calibrations for enzymatic activity estimates in polyhumic Lake Mekkojarvi (Finland) was studied. Two independent fluorescence measurements were tested. MUF calibrations were done under in situ and standard conditions regarding pH, temperature and ion composition. Calibration experiments were successful and significant for both measurements in 1986 and 1987 samples from Mekkojarvi water. The slope of MUF calibration curves varied with sampling time and depths. They were also strongly dependent on pH, DOC and Secchi depths. Phosphatases, glucosidases and aminopeptidases showed the highest activity among studied enzymes. Evaluated enzyme assays were found to be reliable for studying exoenzyme activities in polyhumic lake waters. Calibration curves should be repeated in humic rich water on each sampling date. Standard conditions have to be examined for each lake; no general standard conditions for MUF fluorescence measurements for exoenzyme studies in humic rich water can be recommended. Fluorescence measurements for exoenzyme experiments have to be tested and optimized individually for each sampling station. (Peters-PTT)
W89-13173

ORGANIC MATTER DEGRADATION AND NUTRIENT REGENERATION IN AUSTRALIAN FRESHWATERS: I. METHODS FOR EXOENZYME ASSAYS IN TURBID AQUATIC ENVIRONMENTS.
Murray-Darling Freshwater Research Centre, Albury (Australia).
For primary bibliographic entry see Field 7B.
W89-13174

RELATIVE QUANTITIES AND HETEROTROPHIC ACTIVITIES OF FREE LIVING AND ATTACHED BACTERIA IN A EUTROPHIC LAKE (IMPORTANCE RELATIVE DES FRACTIONS BACTERIENNES LIBRES ET FIXEES EN MILIEU LACUSTRE EUTROPHIC LAKE).
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. de Zoologie.
For primary bibliographic entry see Field 5C.
W89-13175

ADSORPTION OF THREE AMINO ACIDS TO BIOFILMS ON GLASS-BEADS.
Mount Allison Univ., Sackville (New Brunswick). Dept. of Biology.
S. M. Armstrong, and F. Barlocher.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 3, p 391-399, May 1989. 3 fig, 2 tab, 21 ref.

Descriptors: *Biofilms, *Adsorption, *Microbiological studies, *Productivity, *Ion exchange, *Dissolved solids, Algae, Bacteria, Fungi, Laboratory methods, Hydrogen ion concentration, Calcium.

Adsorption of glycine, aspartic acid and lysine by biofilms was studied using glass beads at different pH values, CA(2+) concentrations, and pretreatment of the beads. The positively charged lysine molecules were generally adsorbed more readily than the others. Beads coated with sterile leaf leachate as opposed to sterile glass-beads adsorbed more lysine and aspartic acid, but not glycine. The same pattern was found when beads coated with leachate and colonized by bacteria were compared with beads coated with sterile leachate. Killing the bacteria on the beads with glutaraldehyde did not affect adsorption rates. Increasing Ca(+2) concentration from 5 to 50 mg/L decreased adsorption of lysine and increased adsorption of aspartic acid. These results indicate that adsorption, the first step towards the use of dissolved organic substances by attached microorganisms, is influenced by many factors and that while negative surface charges play an important role, they are not sufficient to explain the entire process. (Author's abstract)
W89-13176

CHANGES IN SEASONAL SUCCESSIONS OF PLANKTON IN LAKE KVERNAVATN, COMPARED TO THE PEG-MODEL.
Bergen Univ. (Norway). Dept. of Microbiology and Plant Physiology.
S. Andersen, G. H. Johnsen, and K. Y. Borsheim.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 3, p 401-415, May 1989. 4 fig, 8 tab, 22 ref.

Descriptors: *Limnology, *Water pollution effects, *Eutrophic lakes, *Eutrophication, *Lake Kvernavatn, *Fish farming, *Lakes, *Mesotrophic lakes, Trophic level, Mesotrophy, Model studies, Aquaculture, Phosphorus, Nitrogen, Primary productivity, Zooplankton, Phytoplankton, Species composition, Seasonal variation, Nutrients, Model studies.

The transition from oligotrophic to eutrophic successions of plankton in Lake Kvernavatn was gradual, compared to the previously described PEG-model. Inorganic plant nutrients and phytoplankton successions were investigated during three years (1983-1985), and zooplankton successions during five years (1981-1985). Since 1979 the lake has received large inputs of inorganic plant nutrients and organic matter from a floating fish farm, and has changed from an oligotrophic towards a eutrophic state. During the years of investigation, both total phosphorus and total nitrogen reached concentrations characteristic to eutrophic lakes. The primary productivity, however, ranged within values which are more typical of mesotrophic lakes. Phytoplankton successions changed to include an increased summer bloom, and the species composition was altered towards larger species. Both events are described for eutrophic lakes in the PEG-model. The seasonal development of zooplankton was of an oligotrophic type according to the PEG-model, showing a single summer maximum during the five years of investigations, although the zooplankton biomass decreased. The slower response by the zooplankton is suggested to be due to their longer life cycles. (Author's abstract)
W89-13177

DENSITIES OF BENTHIC MACROINVERTEBRATES IN UPLAND WELSH STREAMS OF DIFFERENT ACIDITY AND LAND USE.
University Coll., Cardiff (Wales).
N. S. Weatherley, G. P. Rutt, and S. J. Ormerod.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 3, p 417-431, May 1989. 1 fig, 4 tab, 46 ref.

Descriptors: *Acid rain effects, *Benthic fauna, *Population density, *Stream biota, *Acid streams, *Wales, *Land use, *Seasonal variation, Forest watersheds, Time series analysis, Insects, Hardness, Hydrogen ion concentration, Chemical properties, Model studies.

Benthic macroinvertebrates in six Welsh streams of contrasting acidity and land use were sampled quantitatively at nominal monthly intervals over three years. Abundances of the main taxonomic groups were assessed, and time series models fitted to the total densities. Total densities were highest in a circumneutral stream, mainly due to the presence of Ephemeroptera. Plecoptera was the most abundant taxon and had similar absolute abundances at all sites, including conifer afforested and moorland catchments. Dipterans were important at all sites, and in three acidic streams draining moorland the Oligochaeta also represented a major faunal component. In all streams the densities in each month showed low correlations between years, but the range of seasonal variations increased at low pH. There was no strong evidence of changes in stability with acidity, although the patterns of seasonal abundance may have implication for ecosystem interactions. (Author's abstract)
W89-13178

EROSION AND INFILL OF NEW YORK FINGER LAKES: IMPLICATIONS FOR LAURENTIDE ICE SHEET DEGLACIATION.
Syracuse Univ., NY. Dept. of Geology.
H. T. Mullins, and E. J. Hinchey.
Geology GLGYBA, Vol. 17, No. 7, p 622-625, July 17, 1989. 5 fig, 11 ref. National Science Foundation Grant EAR-8607326.

Descriptors: *Finger Lakes, *Geohydrology, *Paleohydrology, *Lake formation, *Ice breakup, *Glaciohydrology, *Glaciers, Laurentide ice sheet, Snowmelt, Bedrock, Sedimentology, Seneca Lake, Cayuga Lake, Deglaciation, Geomorphology, Seismic reflection profiles.

A comprehensive seismic reflection profile investigation of the New York Finger Lakes has revealed the extent of bedrock erosion and nature of sediment fill beneath the lakes. Bedrock deepens to the south, where gorge-like profiles have been eroded to as much as 304 m below sea level and infilled with up to 275 m of late Quaternary age sediment. A working hypothesis has been proposed that invokes ice streaming and pressurized subglacial meltwater and sediment to account for regional geomorphology. This working hypothesis is consistent with recent concepts of the collapse of continental ice sheets via ice streaming and the marine isotopic record for a meltwater spike at 13-14 million years. The Finger Lakes may provide a critical testing ground for deglaciation models of the southern Laurentide ice sheet because they contain a thick, well-preserved, and now seismically defined record of the deglaciation process. (Author's abstract)
W89-13184

ZOOPLANKTON COMMUNITY STRUCTURE AND COPEPOD SPECIES COMPOSITION IN THE NORTHERN GULF OF MEXICO.
Atlantic Oceanographic and Meteorological Labs., Miami, FL.
P. B. Ortner, L. C. Hill, and S. R. Cummings.
Continental Shelf Research CSHRDZ, Vol. 9, No. 4, p 387-402, April 1989. 6 fig, 3 tab, 29 ref.

Descriptors: *Mississippi River, *Gulf of Mexico, *Zooplankton, *Species diversity, *River mouth, *Saline water, *Copepods, Food chains, Fish food, Larvae, Predation, Salinity, Chlorophyll, Temperature.

Zooplankton community structure and copepod species composition were analyzed in samples obtained during spring and winter from three areas of the northern Gulf of Mexico: near the Mississippi River outflow, off Cape San Blas, and in the central Gulf of Mexico. Samples from different regions were distinguishable in correspondence analysis of dominant species and/or functional groups. The near-surface communities of the Mississippi and central Gulf were particularly distinct while Cape San Blas was intermediate in both structure and specific character. Saltier waters directly beneath the Mississippi Plume yielded samples similar to those from near-surface water well offshore. At the same time near-surface waters off the Mississippi and off Cape San Blas to the west were distinguishable even during spring when the outflow from the Mississippi was at its annual peak. These differences are consistent with the discharge and flow patterns of the Mississippi River plume and the northern Gulf and with systematic differences in such parameters as temperature, salinity and chlorophyll concentration. The reported unusually high larval fish abundances near the Mississippi River plume are not unexpected given the high zooplankton biomass. (Author's abstract)
W89-13187

WATER QUALITY 88: SEMINAR PROCEEDINGS.
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 5G.
W89-13231

MULTI-PORTED, SINGLE WET-WELL INTAKE STRUCTURE OPERATION IN A STRATIFIED RESERVOIR.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 5G.
W89-13235

DISSOLVED OXYGEN STUDIES BELOW WATER F. GEORGE DAM.
Army Engineer District, Mobile, AL.
For primary bibliographic entry see Field 5G.
W89-13238

LAKE CHICOT: THE FINAL CHAPTER.
Army Engineer District, Vicksburg, MS.
For primary bibliographic entry see Field 5G.
W89-13240

CUMBERLAND BASIN WATER QUALITY MODEL.
Army Engineer District, Nashville, TN.
For primary bibliographic entry see Field 6G.
W89-13241

WATER QUALITY EVALUATION OF PROPOSED OUTLETS FROM DEVILS LAKE NEAR DEVILS LAKE, ND.
Army Engineer District, St. Paul, MN.
For primary bibliographic entry see Field 4A.
W89-13242

THERMAL STRATIFICATION IN MILL CREEK RESERVOIR.
Corps of Engineers, Walla Walla, WA. Environmental Resources Branch.
T. Bartish.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 95-103, 2 fig, 3 ref.

Descriptors: *Mill Creek Reservoir, *Eutrophic lakes, *Thermal stratification, *Reservoirs, *Water quality, Mixing, Stratification, Turbidity, Water quality, Shallow water, Thermocline, Suspended solids, Oxygen deficit.

Despite its shallow depth, thermal stratification and associated reductions in water quality (anoxia, hydrogen sulfide production) have been occurring in Mill Creek reservoir since 1970. Because the reservoir is highly managed and is very small, these processes do not have significant ramifications to the overall quality of the system. Water quality conditions in Mill Creek reservoir are typically eutrophic. Productivity in the reservoir is moderate. Algal blooms occur but are not commonly observed, due possibly to the limited light penetration associated with the high suspended solids concentrations. Although thermal stratification is not uncommon in shallow impoundments, especially those protected from significant wind activity, the finding of stable stratification in Mill Creek reservoir was surprising. The primary influence on the system is the lack of hydraulic flow-through: inflow is a short-term process, and outflow is diffused over a wide area (through seepage) at a rate of about 5 cu ft/sec (cfs). As expected in stratified shallow water bodies, thermocline development commences at higher water column temperatures (8 to 10 C) when the density differential is greater. The bottom water mass being of low volume in relation to the surface waters, subsequent warming is appreciable, with bottom water temperatures reaching 18 C prior to late summer overturn. Rapid depletion of dissolved oxygen (DO) occurs during stratification and frequently results in anoxia in the bottom waters. Very little regard is given to the prevalence of thermal stratification, anoxia, and hydrogen sulfide production in Mill Creek reservoir, as there exists low potential for significant impacts. No surface water problems (other than occasionally high turbidity) result from the thermal stratification. Surface waters are fairly well mixed and seldom stagnant. (See also W89-13231) (Lantz-PTT)
W89-13243

POST-ERUPTION LIMNOLOGY OF SPIRIT LAKE, MOUNT ST. HELENS, WASHINGTON, 1980-1986: LIMNOLOGICAL RESPONSE TO ACCELERATED LAKE DRAWDOWN VIA TUNNEL DISCHARGE, WITH EMPHASIS ON OXYGEN.
Army Engineer District, Portland, OR. Reservoir Regulation and Water Quality Section.
D. W. Larson.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 104-116, 4 fig, 1 tab, 20 ref.

Descriptors: *Washington, *Volcanoes, *Mount St Helens, *Limnology, *Spirit Lake, *Dissolved oxygen, Microbiological studies, Thermal stratification, Seasonal variation, Mixing, Hypolimnion, Epilimnion, Sediment-water interfaces.

The oxygen supply in Spirit Lake, Washington was rapidly and totally consumed by extraordinarily intense microbial activity during the summer of 1980, shortly after the eruption of Mount St. Helens. The rate of oxygen depletion in Spirit Lake was less severe during the summer of 1981. Dissolved oxygen (DO) was still present to a depth of 18 m on June 29, although these remnant concentrations soon fell to zero. Oxygen persisted in surface waters, however, which were about 50% oxygen-saturated as late as August 31, 1981. The oxygen content of Spirit Lake was measured only twice in 1982. Both profiles were abbreviated, but they indicated that: (1) the lake's epilimnion remained fairly well-oxygenated over much of the summer, at least until July 27; and (2) hypolimnetic oxygen persisted long into the period of summer thermal stratification. These changes represented a marked improvement over summertime oxygen conditions observed in 1980 and 1981. Since 1983, hypolimnetic oxygen consumption has continued to proceed at fairly high rates during summer and fall while the lake is thermally stratified. The rate of oxygen consumption increases toward the lake bottom and is most intense at the sediment-water interface. Each summer, normally in late August or September, much of the hypolimnion becomes anoxic. Possibly, the entire hypolimnion becomes anoxic by the end of thermal stratification, usually in late October. But once the upper portion of the lake begins to cool rapidly, thermal stratification lessens, and complete vertical mixing, or lake turnover, commences. This process of autumnal lake turnover, restores DO to the hypolimnion and maintains nearly isothermal conditions. Finally, rates of hypolimnetic oxygen consumption have diminished year after year, except during summer 1985 when Spirit Lake was rapidly drawn down by tunnel releases. This is part of a larger body of evidence indicating that Spirit Lake continues to recover limnologically. (See also W89-13231) (Lantz-PTT)
W89-13244

WINTER WATER QUALITY IN LAKES AND STREAMS.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 6G.
W89-13245

UNDER-ICE HYDRODYNAMICS AT TIOGA LAKE, PA.
Corps of Engineers, Baltimore, MD. Water Control Management Section.
K. S. Lee, and R. A. Bank.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 125-152, 51 fig, 1 ref.

Descriptors: *Reservoir operation, *Tioga Lake, *Ice, *Hydrodynamics, *Water quality, Limnology, Alkalinity, Hammond Lake, Fishkill, Fisheries, Mixing, Acid mine drainage, Coal mines.

The flexible mode of operation instituted at Tioga Lake, PA during the 1985-86 winter was successful in preventing downstream fishkills. Results of under ice water quality samples taken five times during the winter season indicate that the water in Tioga Lake was mixed during the 1985-86 winter. Profiles from previous years indicated that an alkaline water pocket formed near Mill Creek. This

pocket caused the neutralizing effects of the alkaline Mill Creek water to be wasted. With a mixed lake due to the slow lowering of the pool, water quality control is facilitated. However, use of Hammond waters is necessary to further neutralize Tioga Lake outflows to yield good downstream winter water quality, achievable most of the time. The flexible mode of Tioga-Hammond winter operations is a classic case of conflicting project objectives. Flat pools were maintained in the past for ease of recreational access for winter ice fishing. Reevaluation of project objectives determined that the small inconvenience to ice fishermen is far outweighed by the water quality benefits derived by pool fluctuation. Although fishkills have occurred in and below Tioga Lake in the past, they are a good sign. They are indications that water quality had improved there to the point where fish life could be sustained a majority of the time, and natural fisheries are thriving. While operational procedures may help prevent water quality related fishkills at Tioga Lake, the only true solution would be to attack the root of the problem--acid mine drainage. Cleanup of abandoned coal mines in the Blossburg area upstream of Tioga Dam would not only improve water quality in Tioga Dam, but would restore the polluted Tioga River. With cleanup, the Tioga River upstream of the dam and Tioga Lake could one day become untainted, productive, natural fisheries and a credit to the mine cleanup program. (See also W89-13231) (Lantz-PTT)
W89-13246

APPLICATIONS OF MIXERS AND AERATORS FOR RESERVOIR IMPROVEMENT.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 5G.
W89-13248

DESTRATIFICATION OF BEECH FORK LAKE.
Corps of Engineers, Huntington, WV. Huntington District.
R. E. Punnett.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 185-194, 3 fig.

Descriptors: *Lakes, *Destratification, *Beech Fork Lake, *Water quality control, *Lake restoration, Pumps, Dissolved oxygen, Transmissivity, Limnology, Epilimnion, Thermal stratification, Oxygen deficit, Temperature, Mixing, Dams, Conductivity, Hydrogen ion concentration.

Four Garton-type pumps were used to destratify the 720 acre, 35-ft deep Beech Fork Lake in West Virginia. Each pump had a capacity of about 75 cu ft/sec, a power requirement of 1.1 horsepower, and a six-bladed, 6.0-ft diameter impeller. Temperature, dissolved oxygen (DO), conductivity, pH, transmittance, and some aquatic organisms were monitored. The normal stratification period of 1987 was studied. Considering the temperature and DO profiles as the major indicators of destratification effectiveness, several conclusions were evident: (1) the epilimnion was increased (the major objective); (2) the pumps were sufficient for destratifying Beech Fork Lake even though a strong thermal density difference existed prior to the start of pumping; (3) mixing occurred throughout the lake even though the shape of the lake did not appear to be suited to mixing, and pumping was conducted at only one location; and (4) the water in the vicinity of the dam did not become anoxic. Although at times the overall DO was low, $< 1\%$ of the lake volume became anoxic for a short period. (See also W89-13231) (Lantz-PTT)
W89-13250

SEDIMENT-WATER INTERACTIONS AND CONTAMINANT PROCESSES.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W89-13253

LAKE, MIRE AND RIVER ENVIRONMENTS, DURING THE LAST 15,000 YEARS.
Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. 229p. Edited by Gerhard Lang and Christian Schluchter.

Descriptors: *Geomorphology, *Wetlands, *Aquatic environment, *Paleolimnology, *Paleoclimatology, *Lakes, *Rivers, *Limnology, Alluvial rivers, Conferences.

Most of the papers published in this volume were presented orally or during a poster session at a joint meeting of the 'INQUA-Eurosiberian Subcommission for the Study of the Holocene' with IGCP 158 on 'Palaeohydrology of the temperate zone in the last 15,000 years'. The papers are arranged in three sections: (1) lake and mire environments with 10 contributions; (2) fluvial environments with 9 contributions; and (3) two state-of-the-art papers on fluvial environments. (See W89-13296 thru W89-13315) (Lantz-PTT)
W89-13295

LAGO CADAGNO: AN ENVIRONMENTAL HISTORY.
Queen's Univ., Kingston (Ontario).
M. M. Boucherle, and H. Zullig.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 3-7, 3 fig, 10 ref.

Descriptors: *Switzerland, *Cores, *Landslides, *Lakes, *Limnology, *Avalanches, Aquatic environment, Crustaceans, Ecosystems, Sedimentation, Eutrophication, Landslides, Bacteria, Dams, Lago Cadagno, Waterfleas, History.

During the last 1000 years, Lago Cadagno has been altered by several landslides or avalanches resulting in changes in the lake's biota. Evidence of at least four of these events is reflected by the sudden decrease in the concentration of Cladocera (Crustacea) remains and bacterial pigments from a sediment core. At the time of each of these events sedimentation was increased so much that both kinds of remains were rare due to dilution by allochthonous material. Lago Cadagno has also experienced two periods of eutrophication. Once as a result of the first landslide/avalanche event and the second time due to human habitation in the lake's catchment. The increased production resulted in a higher concentration of Cladocera remains and a shift in species and an increase in the concentration of bacterial pigments. The lake was dammed for hydroelectric power use and this perturbation also altered the biota. (See also W89-13295) (Author's abstract)
W89-13296

LATE-GLACIAL AND EARLY HOLOCENE HISTORY OF THE VEGETATION IN THE WOLBROM AREA (SELESIAN-CRACOVIAN UPLAND, S. POLAND).
Gdansk Univ. (Poland). Dept. of Plant Ecology and Nature Protection.
M. Latalowa.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 9-22, 7 fig, 3 tab, 18 ref.

Descriptors: *Limnology, *Paleolimnology, *Wetlands, *Peat bogs, *Poland, *Palynology, *Cores, Wolbrom, Climatology, Trees.

Pollen analysis and 14-C datings of the bottom sections of three profiles from the Wolbrom peat bog are the basis of the reconstruction of the Late-glacial and early Holocene vegetation history. Three cool and two warm periods of the Late-Glacial period can be distinguished from the pollen analysis. A correlation analysis of the pollen data shows that equivalent zones are often variously represented in the examined material. This situation is due to the differentiation in the local vegetation that grew on the Wolbrom peat-log and concerns mainly the Late-glacial period. The approximate dates when the several trees spread on to the investigated area in the early Holocene was also determined. The vegetation which then was dominant in the Wolbrom area, and in other parts of Poland too, was of the 'park tundra' type. At this time only northern Poland was characterized by much larger numbers of juniper and an even sparser covering of pine and tree-birches. (See also W89-13295) (Lantz-PTT)
W89-13297

POST-GLACIAL, HISTORIC CONTRIBUTIONS OF TWO LAKES OF CLAIRVAUX (JURA, FRANCE): PALYNOLOGICAL AND SEDIMENTOLOGICAL CHANGES (CONTRIBUTION A L'HISTOIRE POSTGLACIAIRE DES DEUX LACS DE CLAIRVAUX (JURA, FRANCE): RECHERCHES PALYNOLOGIQUES ET SEDIMENTOLOGIQUES).
Laboratoire de Chrono-Ecology, Besancon (France).
M. Magny, and H. Richard.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 23-29, 7 fig, 5 ref. English summary.

Descriptors: *Aquatic environment, *Lakes, *Palynology, *Cores, *Limnology, *Paleolimnology, Clairvaux, France, Vegetation, Ecosystems, Water level, Archaeology.

Several sequences of lacustrine sediment from both 'lacs de Clairvaux' (Jura, France), are analyzed. The investigation of the history of the regional vegetation is based on pollen analysis; the human impacts on the vegetation is considered. The investigation of the water level changes is based on sediment analysis. Archaeological layers and 14-C datings provided an accurate time scale for the study. (See also W89-13295) (Author's abstract)
W89-13298

DIATOMS IN BOTTOM SEDIMENTS OF LAKE HOBSCHEN, SIMPLON, SWITZERLAND: PRELIMINARY REPORT.
Polish Academy of Sciences, Warsaw. Geological Sciences Inst.
B. Marciniak.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 31-39, 2 fig, 7 plates, 16 ref.

Descriptors: *Paleolimnology, *Limnology, *Diatoms, *Cores, *Switzerland, Bottom sediments, Lake Hobschen, Lithology, Fragiyaria.

A preliminary diatom analysis of the lower part of sediments (depth 977.5-895 cm) from Lake Hobschen enabled six diatom phases (H1-H6) concordant with a lithologic subdivision of sediment to be distinguished. In the lowermost part of the section a very low frequency of diatoms was observed (phase H1-H3) while the overlying sediments (depth 942.5-895 cm) contained numerous and highly varying diatom species (phase H4-H6). During the diatom phase H4 a rapid development of the genus Fragilaria occurred. A considerable drop in diatom frequency was noted in the phase H5. The dominance of the genus Fragilaria (excl. F. alpestris, F. pinnata) decreases whereas the genera Amphora, Pinnularia, Caloneis, Hantzschia, Ceratoneis and Diatoma became more important. In the phase H6 a renewed development of some Fragilaria species occurred accompanied by the geneia Navicula, Achnanthes, Synedra and Eunotia. (See also W89-13295) (Author's abstract)
W89-13299

PALYNOLOGICAL AND ISOTOPE STUDIES ON CARBONATE SEDIMENTS FROM SOME POLISH LAKES--PRELIMINARY RESULTS.
Academy of Mining and Metallurgy, Krakow (Poland). Inst. of Physics and Nuclear Techniques.
K. Rozanski, D. Weislo, K. Harmata, B. Noryskiewicz, and M. Ralska-Jasiewiczowa.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 41-49, 4 fig, 22 ref.

Descriptors: *Limnology, *Paleolimnology, *Cores, *Palynology, *Lake sediments, *Poland, History, Lake Strazym, Paleohydrology, Lake Mikolajki, Isotope studies, Carbonates, Pollen, Climatology.

Presented are preliminary results of palynological and isotope (gamma-18-O, gamma-13-C) investigations performed on lake sediment cores originating from three sites in Poland: a fossil oxbow lake of late-glacial age (Roztoki, SE Poland), Lake Strazym situated near Brodnica (NC Poland), and Lake Mikolajki belonging to the East Baltic Lake Districts (NE Poland). In general, good agreement was found between palynological and isotope data. Periods of colder climate as indicated by pollen diagrams, are also seen on the gamma-18-O profiles as a distinct minima in the 18-O content of the lake carbonate. The gamma-13-C data indicate possible changes in biological activity of the investigated lakes and/or climate induced fluctuations in their water level. The rise of temperature at the beginning of Holocene as inferred from the N-Polish isotope profiles, with its first culmination occurring close to the end of Preboreal, seems to have been delayed by several hundreds of years in comparison with the south-west areas of central Europe. (See also W89-13295) (Author's abstract)
W89-13300

PECULARITIES OF SEDIMENTATION IN THE SMALL ESTONIAN LAKES.
Akademiya Nauk Estonskoi SSR, Tallinn. Inst. Geologii.
For primary bibliographic entry see Field 2J.
W89-13301

PRINCIPLES OF THE PALAEOECOLOGICAL SUBDIVISION OF THE EUROPEAN PART OF THE USSR.
Akademiya Nauk Estonskoi SSR, Tallinn. Inst. Geologii.
L. Saarse, A. Raukas, and D. Kvasov.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 77-82, 1 fig, 21 ref.

Descriptors: *Paleolimnology, *Lakes, USSR, Climatology, Glaciation, Geomorphology, Paleohydrology.

The European part of the USSR occupies a large territory with different geological, geomorphological and climatic conditions as well as vegetation. Phytogeographers have distinguished tundra, woodland tundra, northern, central and southern Boreal (taiga), Boreo-nemoral, Nemorarl, woodland Steppe, Steppe and Steppe Desert zones and subzones. Taking into consideration geological and geomorphological peculiarities of the relief formed during the different glaciations in the territory of the Russian SFSR the following 8 lake districts can be differentiated: (1) far north-east bounded by the Rivers Usa, Pechcora and Tsilma in the south including also the watershed of the rivers on the Kanin peninsula and Cheskaya Bay; (2) the north-west which intersects the ice marginal zone of Weichselian glaciation in the line which runs through Pskov, Staraya-Russa and Vyshegorsk, and coincides with it in the south-east; (3) the taiga zone, which has few lakes beyond the limits of Weichselian glaciation; (4) the north-west Boreo-nemoral zone, which coincides with the limits of Weichselian glaciation; (5) the periglacial area, with few lakes; (6) woodland Steppe, where there are only a few lakes left on the terraces of river valleys; (7) the Steppe zone which is characterized by very small number of lakes among which the oxbow lakes dominated; and (8) the Steppe-Desert with lakes that are typical oxbow lakes and located mainly in the river valleys or delta plains. (See also W89-13295) (Lantz-PTT)
W89-13302

SYNCHRONOUS POLLEN CHANGES AND TRADITIONAL LAND USE IN SOUTH FINLAND, STUDIED FROM THREE ADJACENT SITES: A LAKE, A BOG AND A FOREST SOIL.
Oulu Univ. (Finland).
K. Tolonen, and M. Tolonen.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 83-97, 8 fig, 17 ref.

Descriptors: *Limnology, *Palynology, *Cores, *Finland, *Lake sediments, *Land use, *Bogs, Forest soils, History, Diatoms, Peat, Peat bogs, Farming.

Previous diatom analyses on a sediment core spanning the late Holocene from a remote forest lake (Lake Vitsjon) revealed changes that were attributed possibly to early land use around the basin. Fine resolution pollen analysis was undertaken on the uppermost 95 cm of a replicate short core from the lake. The pollen was compared with that from a peat profile from an adjacent small bog and that from a forest soil. The lake core and the peat core were dated by a total of six radiocarbon dates. When using the same basic AP pollen sum from all sites and types of deposits, the history of forests and land use in the study area was evident most clearly in the pollen profile from the lake. The onset of rye cultivation in the region was radiocarbon dated to the Viking period, about A.D. 800, in the Vitsjon core. However, it was not until the hydroseral development of the mire had successed from an alder and birch swamp to a more open Sphagnum-pine bog in early Medieval Times (after A.D. 1200) that any signs of human activity became visible in the pollen spectra from the peat core. Carbonized seeds of Hordeum vulgare with other macrofossils of weels in the soil core provided direct evidence for ancient in situ cultivation in the vicinity of the lake. (See also W89-13295) (Author's abstract)
W89-13303

SEDIMENTATION AND LOCAL VEGETATION DEVELOPMENT OF A REFERENCE SITE IN SOUTHWESTERN BULGARIA.
Sofia Univ. (Bulgaria). Faculty of Biology.
For primary bibliographic entry see Field 2J.
W89-13304

EVOLUTION OF THE THESSALONIKI-GIANNITSA PLAIN IN NORTHERN GREECE DURING THE LAST 2500 YEARS--FROM THE ALEXANDER THE GREAT ERA UNTIL TODAY.
Thessaloniki Univ., Salonika (Greece). Dept. of Geology and Physical Geography.
T. A. Astaras, and L. Sotiriadis.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 105-114, 6 fig, 17 ref.

Descriptors: *Greece, *Limnology, *Paleolimnology, *Geomorphology, *Paleohydrology, *Deltas, *Alluvial plains, Thessaloniki-Giannitsa plain, History, Gulfs, Palynology, Radioactive dating.

A chronology for the paleogeographical evolution of the Thessaloniki-Giannitsa plain during the last 2500 years by a combination of information on palynological and radiocarbon data, archaeological and geomorphological/geological evidence and historical records were established. The Thessaloniki plain has been formed mainly by the progradation of the deltas of the Axios in the north and the Aliakmon River in the south-west. The positive epeirogenic movement (uplift) which is taking place in this area during the Holocene period is also largely responsible for the regression of the sea from the plain. Before the era of the Macedonia king, Alexander the Great (Ca. 500 B.C.) the Thermaikos gulf reached Pella and other ancient cities. Later, the continued progradation of the deltas of the Axios and Aliakmon River reduced the size of the gulf, and during first Century B.C. and the first Century A.D., the inner part of the gulf was connected to the rest of the Thermaikos gulf by a narrow channel only. During the fifth Century A.D. the inner part of the gulf was cut off completely and formed the Ludias lake (later named Giannitsa Lake) which was drained by Ludias River until the 1930's. The Giannitsa lake was then completely drained for agricultural purposes. Today extensive irrigation is used in the cultivation of the plain. (See also W89-13295) (Author's abstract)
W89-13305

LAKE LEVEL CHANGES AND FLUVIAL ACTIVITY IN THE LATE GLACIAL LOWLAND VALLEYS.
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
S. Bohncke, J. Vandenberghe, and T. A. Wijmstra.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 115-121, 4 fig, 28 ref.

Descriptors: *Limnology, *Paleolimnology, *Paleoclimatology, *Water level fluctuations, *Lakes, *Paleohydrology, *The Netherlands, *Belgium, Climatology, Sedimentology, Geomorphology, Swamps, Drought, Glaciation.

Phases of alternating dry and wet conditions during the Late Glacial may be caused by geomorphological-hydrological phenomena and by climatic changes. The conditions of humidity in lowland valleys are expressed in lakes of fluvial origin ('valley lakes'), in backswamps on low terraces and in lakes formed in pingo remnants which are also situated in valley depressions. Based on paleobotanical, chemical, sedimentological and geomorphological information collected from the three environments is and compared, a short, dry phase is found in the pingo-remnants as well as on the valley terrace which represents the Older Dryas. The drought is caused by lowering of the water table due to deep river incisions and thus is of exclusively geomorphological origin. Several fluctuations are recognized during the Allerod. A second dry phase is generally found at the end of the Allerod. A third major minimum in the lake levels is reached in the later part of the Younger Dryas and coincides with widespread aeolian dune formation. The latter two dry periods can mainly be attributed to climatic causes. (See also W89-13295) (Author's abstract)
W89-13306

NEW METHODS OF RESEARCH ON THE HOLOCENE PALEOHYDROGRAPHY OF HUNGARY.
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
K. Mike.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 137-144, 7 fig.

Descriptors: *Geomorphology, *Geologic history, *Rivers, *Paleohydrology, *Hungary, History,

Geohydrology, Lakes, Lake morphology, Subsidence, Radioactive dating, Dendrochronology, Geologic mapping, Data interpretation.

About 2/3 of the area constituting Hungary is filled-up flatland, a subsiding terrain. Holocene paleohydrographical investigations (investigations of terraces, mineral and particle-size composition, wear, roundness, radiocarbon, dendrochronological and paleontological, research, and information from wells) did not give reliable answers to questions of lowland paleohydrography, where in space and time events occurred or their interrelations. A new methodology utilizing level-correction relief-reconstruction is able to reconstruct the former relief, based on recent land-surface height data and height-differences which occurred during the last 100 years. With the application of these multi-method approaches, the hydrographic picture certain centuries can be reconstructed--and it can be further checked and made more accurate by conventional methods. In areas having a different geological history, the reconstruction of paleohydrography might be done using other methods. The paleohydrographic changes explored by different means have to be put together--like the pieces of a mosaic--into a single sequence of events (either in terms of a country or a continent). Based on these investigations it can be said that in Hungary the genesis of lakes is closely related to the history of paleo-rivers. During the Holocene, most of the large lakes became independent from the rivers, which continued their own evolution. (See also W89-13295) (Lantz-PTT)
W89-13309

GEORGIA WETLANDS: TRENDS AND POLICY OPTIONS.
Georgia Univ., Athens. Carl Vinson Inst. of Government.
For primary bibliographic entry see Field 6E.
W89-13391

MANAGEMENT OF GEORGIA'S MARSHLANDS UNDER THE COASTAL MARSHLANDS PROTECTION ACT OF 1970.
Georgia Univ., Athens. Carl Vinson Inst. of Government.
For primary bibliographic entry see Field 6E.
W89-13392

QUALITATIVE AND QUANTITATIVE AQUATIC ALGAL DATA COMPILATION TO DETERMINE MACROTRENDS-IV.
Arkansas Univ., Fayetteville. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 7C.
W89-13401

2I. Water In Plants

WATER RELATIONS OF COCONUT PALMS AS INFLUENCED BY ENVIRONMENTAL VARIABLES.
Central Plantation Crops Research Inst., Kasaragod (India).
K. V. Kasturiabai, S. R. Voleti, and V. Rajagopal.
Agricultural and Forest Meteorology AFMEEB, Vol. 43, No. 3/4, p 193-199, September 1988. 3 fig, 1 tab, 14 ref.

Descriptors: *Radiation, *Temperature effects, *Evapotranspiration, *Vapor pressure, *Leaves, *Plant water potential, *Palm trees, Stomata, Meteorological data collection, Temperature effects, Water potentials, Hydrologic cycle, Seasonal variation, Environmental effects, Drought resistance.

The influence of the agrometeorological parameters of radiation, temperature and vapor pressure deficit (VPD) on the development of stress in coconut palms (Cocos nucifera L.) was studied. A steady state porometer was employed to measure both meteorological parameters and stomatal resistance under filed conditions. Between 10.00 and 12.00 hours, there were increases in radiation, temperature and vapor pressure deficit (VPD). During this period, the stomatal resistance reached a maximum and the leaf water potential was reduced. During the wet season, there was low radiation, temperature and VPD that resulted in the palms showing low stomatal resistance, whereas during the dry season the reverse situation occurred. West Coast Tall palms responded to dry weather through a high leaf diffusive resistance, while the hybrid dwarf x tall was susceptible to stress conditions. (Author's abstract)
W89-12330

WINTER WHEAT RESPONSE TO WATER AND NITROGEN IN THE NORTH AMERICAN GREAT PLAINS.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
R. J. Reginato, J. L. Hatfield, A. Bauer, K. G. Hubbard, and B. L. Blad.
Agricultural and Forest Meteorology AFMEEB, Vol. 44, No. 2, p 105-116, December 1988. 1 fig, 13 ref.

Descriptors: *Fertilization, *North America, *Irrigation, *Nitrogen, *Wheat, *Great Plains, *Plant growth, *Crop yield, *Soil-water-plant relationships, Plant growth substances, Nitrogen cycle, Soil water, Micrometeorology, Climatology, Irrigation practices, Canopy, Fertility.

A unique, identical experiment was conducted at 5 locations in the North American Great Plains, from Alberta, Canada, to Texas, U.S.A., in 1985 and 1986, to investigate the response of winter wheat (Triticum aestivum L.) to water and nitrogen fertility treatments under these climatic regimes. The experimental design consisted of 4 nitrogen levels, 3 irrigation regimes, 2 cultivars, with 4 replications. One cultivar, Colt, was common to all locations. Crop response throughout the growing season was monitored by intensive plant sampling, measuring spectral reflectance, evaluating canopy temperature, and by detailed measurements of the microclimate and of soil water content. Data on soil classification, irrigation amounts and dates, fertilizers, daily weather, planting information, plant canopy height, and plant harvest were compiled. (See W89-12334 thru W89-12338) (Friedmann-PTT)
W89-12333

MONITORING THE WEATHER AT FIVE WINTER WHEAT EXPERIMENTAL FIELD SITES.
Nebraska Univ.-Lincoln. Center for Agricultural Meteorology and Climatology.
For primary bibliographic entry see Field 2B.
W89-12334

WINTER WHEAT GRAIN YIELD RESPONSE TO WATER AND NITROGEN ON THE NORTH AMERICAN GREAT PLAINS.
Department of Agriculture, Lethbridge (Alberta). Research Station.
D. J. Major, B. L. Blad, A. Bauer, J. L. Hatfield, and K. G. Hubbard.
Agricultural and Forest Meteorology AFMEEB, Vol. 44, No. 2, p 141-149, December 1988. 2 fig, 4 tab, 16 ref.

Descriptors: *Nitrogen, *North America, *Wheat, *Crop yield, *Soil-water-plant relationships, *Plant growth, *Soil water, *Plant growth substances, *Great Plains, Nitrogen cycle, Fertility, Irrigation, Water stress.

Soil moisture and nitrogen availability and location are the main factors influencing winter wheat yields on the Great Plains. A study was conducted in 1985 and 1986 at five locations with three soil water levels and four nitrogen levels to investigate yield and yield components of winter wheat. Potential yields increased with latitude but rainfed yields were similar at all sites, confirming that moisture stressis the most limiting factor on the Great Plains. Kernels per spike increased with latitude. Optimum fertility rate was about 160 kg of N/ha. Kernel weight decreased and spike numbers increased as nitrogen was increased. Increased yields from irrigation cam mainly through an increased number of spikes. The three components of yield, spike number, kernels per spike and kernel weight, were significantly and positively related to yield but kernel weight and spike number appeared to be the main determinants of final grain yield. (See also W89-12333) (Author's abstract)
W89-12335

SEASONAL PATTERNS OF WINTER WHEAT PHYTOMASS AS AFFECTED BY WATER AND NITROGEN ON THE NORTH AMERICAN GREAT PLAINS.
Agriculture Canada, Lethbridge (Alberta). Research Station.
D. J. Major, B. L. Blad, A. Bauer, J. L. Hatfield, and K. G. Hubbard.
Agricultural and Forest Meteorology AFMEEB, Vol. 44, No. 2, p 151-157, December 1988. 1 fig, 2 tab, 14 ref.

Descriptors: *Biomass, *North America, *Plant growth, *Growth rates, *Soil-water-plant Relationships, *Soil water, *Wheat, *Great Plains, *Nitrogen, Nitrogen cycle, Phytomass, Plant growth substances, Seasonal variation, Crop production, Nitrogen, Climatology, Irrigation effects, Rainfall.

Seasonal phytomass of winter wheat was studied at 5 locations on the North American Great Plains to assess differences in productivity at 3 soil water and 4 nitrogen levels. The average temperature at the time of rapid production of whole-plant phytomass was 11 C and varied from 6 to 14 C. Subsequently, temperature regimes at the 5 locations were similar, even though they occurred at different times of the year. Growth rates varied among locations and durations varied between years. At the three most southerly locations, maximum whole-plant phytomass occurred shortly after the onset of rapid grain filling, whereas at the two northern locations, maximum whole-plant phytomass occurred at, or shortly before, maximum grain dry weight. The reason for this phenomenon was apparently a much greater production of vegetative tissue at the southern locations. Whole-plant and grain growth rates under rainfed conditions were 70 and 62% of the irrigated values, respectively. The daily growth rate of spikes was equal to the whole-plant growth rate in the irrigated/high N treatments. Duration of growth was reduced only by 3 days under rainfed/low N conditions for both whole-plant and head phytomass. (See also W89-12333) (Author's abstract)
W89-12336

INFLUENCE OF WATER AND NITROGEN LEVELS ON CANOPY TEMPERATURES OF WINTER WHEAT GROWN IN THE NORTH AMERICAN GREAT PLAINS.
Nebraska Univ.-Lincoln. Center for Agricultural Meteorology and Climatology.
B. L. Blad, A. Bauer, J. L. Hatfield, E. T. Kanemasu, and D. J. Major.
Agricultural and Forest Meteorology AFMEEB, Vol. 44, No. 2, p 159-173, December 1988. 9 fig, 1 tab, 15 ref.

Descriptors: *Nitrogen, *Temperature, *North America, *Canopy, *Wheat, *Heat transfer, *Great Plains, *Hydrologic cycle, *Evapotranspiration, Water stress, Plant growth substances, Plant growth, Fertility, Nitrogen cycle, Infrared imagery.

Canopy temperatures of winter wheat were measured with infrared thermometers in 1985 and 1986 at five locations in the North American Great Plains. These measurements were made to determine the occurrence and severity of water stress resulting from different water treatments and to evaluate the influence of nitrogen (N) fertilization on canopy temperatures. Study results suggest that water stressoccurred at locations in the northern and southern Great Plains in both 1985 and 1986, but not at the mid-Plains locations. The influence of N fertilization on canopy temperature was not consistent among locations nor even between years at the same location. At Mandan, ND, the level of N fertilization had a significant impact on the canopy temperature in both years while at Lethbridge, Canada, it had no effect in either year. At

the other locations, the level of N fertilization influenced the canopy temperature in one year, but not the other. In some locations, there was an apparent cultivar effect on the canopy temperature. Colt, as indicated by canopy temperature data, did not grow as well at the northern and southern locations as it did at the mid-Plains locations. Colt was developed in the mid-Plains environment, which may explain its better performance at the mid-Plains locations. (See also W89-12333) (Author's abstract)
W89-12337

YIELD AND WATER USE OF WINTER WHEAT IN RELATION TO LATITUDE, NITROGEN AND WATER.
Agricultural Research Service, Lubbock, TX. Cropping Systems Research Service.
J. L. Hatfield, A. Bauer, E. T. Kanemasu, D. J. Major, and R. J. Reginato.
Agricultural and Forest Meteorology AFMEEB, Vol. 44, No. 2, p 187-195, December 1988. 2 fig, 5 tab, 11 ref.

Descriptors: *Fertilization, *Nitrogen, *Wheat, *Crop yield, *Soil-water-plant relationships, *Evapotranspiration, Precipitation, Rainfall, Plant growth, Agriculture, Great Plains, Irrigation practices, Water use, Soil water, Nitrogen cycle, Plant growth substances.

The yield of wheat in response to fertilizer nitrogen (N) and water is not consistent at different locations. A study was conducted at five latitudes in the Great Plains for 2 years, each with three levels of water and two of N to investigate their effect on grain yield, total aerial biomass and water-use-efficiency (WUE) of wheat. Evapotranspiration (ET) was calculated from weekly measurements of soil water content, daily precipitation and irrigation amounts. ET was not affected by the level of available N within a soil water treatment, even though grain yield and total aerial biomass were increased by both N and water level. WUE for both grain yield and total aerial biomass was correlated with latitude, year and N. The ability of winter wheat plants to produce aerial biomass and yield improved as the available N increased without a concurrent increase in ET. Management practices for the application of N in rain-fed agriculture must consider the availability of soil water. (See also W89-12333) (Author's abstract)
W89-12338

TESTING A THEORETICAL CLIMATE-SOIL-LEAF AREA HYDROLOGIC EQUILIBRIUM OF FORESTS USING SATELLITE DATA AND ECOSYSTEM SIMULATION.
Montana Univ., Missoula. School of Forestry.
R. R. Nemani, and S. W. Running.
Agricultural and Forest Meteorology AFMEEB, Vol. 44, No. 3/4, p 245-260, January 1989. 6 fig, 1 tab, 34 ref. NASA Grant NAGW-952. NASA/Ames Research Center Grants NCA 2-138 and NCA 2-27.

Descriptors: *Satellite technology, *Simulation analysis, *Leaves, *Soil water, *Soil-water-plant relationships, *Hydrologic budget, *Forest hydrology, *Evapotranspiration, Ecosystems, Remote sensing, Climate, Model studies, Precipitation, Theoretical analysis, Coniferous forests, Evapotranspiration potential.

It is hypothesized that a necessary equilibrium exists between climate, soil water-holding capacity and maximum leaf area in water limited coniferous forest ecosystems. To test this hypothesis over a large range of forests in Montana, spectral reflectance data from two different satellite sensors, Landsat/Thematic Mapper and NOAA/AVHRR, were combined with leaf area index (LAI) measured or simulated from a forest ecosystem model, FOREST-BGC. Transpiration simulated by the model with representative climatic and soil data was used to calculate equilibrium leaf area index of 20 mature conifer forest stands across Montana. A strong correlation was found between calculated and field measured of leaf area index, R squared = 0.87. To test if satellite data can estimate LAI, measured leaf area index was correlated with spectral reflectance data from TM computed as the Normalized Difference Vegetation Index (NDVI) for 17 stand (R squared = 0.58). Then, LAI for 53 conifer stands across Montana was estimated using the current equilibrium concept and related to AVHRR/NDVI at 1.1 km scale (R squared = 0.88). Species composition was found to be important only at the TM pixel scale of 30 m. AVHRR/NDVI provided an initial validation of the hydrologic equilibrium theory at regional scales. A quantitative relationship between climate defined simply as precipitation/potential evaporation, soil water-holding capacity and leaf area was developed using the model simulations. This relationship allows the prediction of either equilibrium leaf area index or soil water-holding capacity if the other is known. (Author's abstract)
W89-12339

SEASONAL CHANGE IN WATER USE AND CARBON ASSIMILATION OF IRRIGATED WHEAT.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
F. X. Dunin, W. S. Meyer, S. C. Wong, and W. Reyenga.
Agricultural and Forest Meteorology AFMEEB, Vol. 45, No. 3/4, p 231-250, March 1989. 8 fig, 1 tab, 33 ref.

Descriptors: *Water use, *Wheat, *Absorption, *Micrometeorology, *Evaporation, *Soil-water-plant relationships, *Irrigation, *Carbon, Seasonal variation, Plant growth, Plant growth substances, Water vapor, Hydrologic cycle, Water use efficiency, Australia.

Measurements of evaporation and net assimilation rate of irrigated wheat at Griffith, New South Wales, were made during 73 days from full cover to physiological maturity. Micrometeorological determinations of flux densities of water vapor and CO2 were based on the energy balance or Bowen ratio technique. Complementary measurements involving weighing lysimetry, soil water content and plant dry matter indicated that crop water use and growth could be explained in terms of a series of hourly values of these fluxes. Daily rates of evaporation increased about 3-fold to 10 mm/day during the study period. Estimates of potential evaporation consistently underestimated measured evaporation until the final 20 days, when declining soil water and crop senescence reduced evaporation rates. Net daytime assimilation rates of CO2 were nearly constant with time prior to anthesis, with day-to-day variability being an order of magnitude less than that for evaporation rate. Both daily and peak rates of net assimilation were generally greater than those reported for dryland wheat in southern Australia, but were comparable with those for irrigated sunflower. During the post-anthesis phase, a progressive decline in rate was observed. The initial decline was attributed to crop lodging, but late reductions were thought to be due to the combined effect of soil water depletion and crop senescence. A loss in water use efficiency of 24% from the pre to post-anthesis stages was determined from harvests of standing crop material near anthesis and at physiological maturity. The ratio of hourly evaporation to net assimulation was positively correlated with vapor pressure deficit to explain, in part, the observed reduction as a response to decreasing relative humidity with progression into the reproductive stage. Lodging and senescence of the crop were identified as additional factors that depressed water use efficiency during this stage. An improved understanding of the dynamics of water-use efficiency requires further development in measurement to partition fluxes of gaseous exchange between plant and soil. (Author's abstract)
W89-12340

EFFECT OF WATER DEFICIT AT DIFFERENT GROWTH PHASES OF PEANUT: III. RESPONSE TO DROUGHT DURING PREFLOWERING PHASE.
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
R. C. Nageswara Rao, J. H. Williams, M. V. K. Sivakumar, and K. D. R. Wadia.
Agronomy Journal AGJOAT, Vol. 80, No. 3, p 431-438, May-June 1988. 9 fig, 4 tab, 21 ref.

Descriptors: *Plant growth, *Water deficit, *Peanuts, *Crop yield, *Drought, Agricultural hydrology, Plant physiology, Cultivation, Irrigation, Water stress.

Water deficits can affect peanut yields differentially depending on time of occurrence and intensity. Previous reports have shown that moderate water deficit during the preflowering phase increases pod yields by 13 to 19% relative to the fully irrigated control. Crop physiological factors are presented, more quantitatively, that contribute to these increased yields. In the 1980 to 1981 and 1981 to 1982 post-rainy seasons, a study was conducted on a medium deep Alfisol at the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) in central India, to examine the responses of peanut (Arachis hypogaea L.), cv. Robut 33-1, under three levels of soil water deficits during preflowering phase relative to an adequately irrigated control. Three intensities of drought were created (from 10-50 d after sowing (DAS)) using-line source sprinkler irrigation, while the control was irrigated at 10-d intervals. Moderate water deficits during the preflowering phase increased subsequent crop growth and pod growth rates in 1980 to 1981 but not in 1981 to 1982. Differences in flowering and total pod numbers between treatments were relatively small when compared to the subsequent differences in pod setting and maturity. In both seasons, greater synchrony of pod set in the moderately stressed plots resulted in a greater proportion of mature pods at final harvest. The most severely stressed plot had lower yields despite adequate irrigation subsequent to the preflowering water deficits. (Author's abstract)
W89-12346

EFFECTS OF OZONE AND WATER STRESS ON CANOPY TEMPERATURE, WATER USE, AND WATER USE EFFICIENCY OF ALFALFA.
California Univ., Riverside. Statewide Air Pollution Research Center.
P. J. Temple, and L. F. Benoit.
Agronomy Journal AGJOAT, Vol. 80, No. 3, p 439-447, May-June 1988. 3 fig, 8 tab, 33 ref.

Descriptors: *Water use, *Water use efficiency, *Air pollution effects, *Ozone, *Water stress, *Water deficit, *Alfalfa, *Canopy, *Irrigation effects, *Temperature effects, Temperature gradient, Agricultural hydrology, Crop yield, Soil water, Loam, Absorption, Plant growth, Aging.

Ozone (O3) and soil water deficit are two environmental stresses that significantly affect the growth and yield of alfalfa (Medicago sativa L.). However, little is known of the responses of field-grown alfalfa to O3, and the effects of the interaction between O3 and water stress on canopy temperature and water relations of alfalfa have not been previously reported. The objective of this 2-yr study was to determine the interactive effects of O3 and soil water deficits on canopy temperatures, water use, and water use efficiency (WUE) of alfalfa. Alfalfa (cv. WL-514) was grown in 30-3 by 5.5-m plots on Wasco sandy loam (coarse-loamy, mixed, nonacid, thermic Typic Torriorthents) in Shafter, CA, and was exposed in open-top chambers to five levels of O3 for 12 h daily, from March to October of 1984 and 1985. Ozone treatments ranged from charcoal-filtered air (CF) to twice ambient O3 concentrations. Each plot received either normal amounts of irrigation (NI) or 30% less than normal (WS). Canopy temperature-air temperature differentials were significantly reduced by water stress an average of 27.9% in 1984 and 44.0% in 1985. Ozone also significantly reduced canopy temp.-air temp. differentials by 31% in NI and 37% in WS plots in 1984, but in 1985 O3 had no effect on canopy temp.-air temp differentials. Water use, rate of soil water depletion, or depth of effective rooting zone were not affected by O3, whereas water stress significantly reduced all three. Water use efficiency was significantly reduced by O3, averaging 12% lower in nonfil-

tered compared with CF plots. The effects of O3 on WUE were attributed to premature senescence and abscission of older alfalfa leaves. (Author's abstract)
W89-12348

CROP WATER STRESS INDEX AND YIELD OF WATER-DEFICIT-STRESSED ALFALFA.
Agricultural Research Service, Prosser, WA. Irrigated Agriculture Research and Extension Center.
M. J. Hattendorf, R. E. Carlson, R. A. Halim, and D. R. Buxton.
Agronomy Journal AGJOAT, Vol. 80, No. 6, p 871-875, November-December 1988. 5 fig, 3 tab, 17 ref.

Descriptors: *Water stress, *Water deficit, *Crop yield, *Alfalfa, *Plant growth, *Soil-water-plant relationships, Canopy, Temperature gradient, Cultivation, Agricultural hydrology, Vapor pressure, Hydrologic cycle.

The yield relationship of water-deficit-stressed alfalfa (Medicago sativa L.) with the Crop Water Stress Index (CWSI) may be dynamic over the alfalfa harvest period. This investigation was conducted to define the alfalfa yield-CWSI relationship(s), to test possible advantages of using the CWSI over the canopy-minus-air temperature (T sub c minus T sub a) differential, and to combine the yield-CWSI relationship with a growth function. 'Apollo II' alfalfa was grown for 2 yr in 100-L containers set into the ground and protected from rain by a movable shelter. The soil was a Nicollet silt loam topsoil (fine-loamy, mixed mesic Aquic Hapludoll). Treatments were irrigation levels of 112, 100, 88, 77, and 65% field capacity. Five harvests were taken at 7-d intervals beginning 21 d after an initial clipping. Canopy temperatures were taken daily with an infrared thermometer. A series of exponential yield-SWSI curves resulted rom the sequential harvests. Yield reductions of about 10% and 20% resulted from mean CWSI of 0.05 and 0.10, respectively, over 42-d periods. The Gompertz growth function was modified for water-deficit-stress by combining it with the exponential yield-CWSI relationship. Vapor-pressure deficit (VPD0 effectively normalized the (T sub c minus T sub a) data, allowing yield data of the 2 yr to be combined in the yield-mean CWSI relationship. Yield and T sub c minus T sub a data not normalized for VPD showed clear separation by year for slight VPD differences. Alfalfa yield response to water-deficit-stress over time appeared to be adequately described by the combined Gompertz function and the yield-CWSI ((T sub c minus T sub a) normalized for VPD) curves. (Author's abstract)
W89-12350

WATER TRANSFER THROUGH COTTON PLANTS CONNECTING SOIL REGIONS OF DIFFERING WATER POTENTIAL.
Minnesota Univ., St. Paul. Dept. of Soil Science.
J. M. Baker, and C. H. M. van Bavel.
Agronomy Journal AGJOAT, Vol. 80, No. 6, p 993-997, November-December 1988. 7 fig, 29 ref.

Descriptors: *Soil water potential, *Soil water, *Water potentials, *Root zone, *Soil-water-plant relationships, *Cotton, *Agricultural hydrology, Cultivation, Irrigation effects, Hydrologic properties, Percolation, Evaporation, Simulation.

Several studies have shown that water can move through plant root systems from wet to dry soil during periods of low evaporative demand. It has been suggested that such movement could be important in alternate furrow or drip irrigation systems, where water is applied to a discrete of nonuniform manner. This question was examined, using a physical experiment and computer simulation. A growth chamber experiment was conducted with three rows of cotton (Gossypium hirsutum L.) plants. The outer row plants were grown over vertical barriers such that half of their root systems shared a volume of soil with the center row plants, while the other half was hydraulically isolated in separate soil compartments. The center compartment was allowed to dry, while the out compartments were watered daily. Soil moisture was measured throughout all compartments twice daily by gamma densitrometry. When the potential gradient between center and outer compartments reached 1.0 MPa, the gamma readings showed overnight movement of water from wet to dry soil that could only have taken place through the root systems of the outer row plants. The overnight transfer of water, while significant, was not sufficient to fully supply the daytime transpiration demand of the unirrigated center row plants. It was also less than that predicted by computer simulation, unless the latter reflected the inability of the xylem water potential of cotton plants to equilibrate with soil water potential during periods of low evaporative demand. Regardless, the results suggest that water transfer by root systems should not be excluded in simulations of water movement in the soil-plant-atmosphere system. (Author's abstract)
W89-12353

LEAF WATER POTENTIAL, RELATIVE WATER CONTENT, AND DIFFUSIVE RESISTANCE AS SCREENING TECHNIQUES FOR DROUGHT RESISTANCE IN BARLEY.
Bangladesh Agricultural Univ., Mymensingh. Dept. of Soil Science.
For primary bibliographic entry see Field 3F.
W89-12354

INFLUENCE OF CROP WATER ENVIRONMENT AND DRY MATTER ACCUMULATION ON GRAIN YIELD OF NO-TILL WINTER WHEAT.
Saskatchewan Univ., Saskatoon. Crop Development Centre.
M. H. Entz, and D. B. Fowler.
Canadian Journal of Plant Science CPLSAY, Vol. 69, No. 2, p 367-375, April 1989. 1 fig, 2 tab, 29 ref.

Descriptors: *Crop yield, *Wheat, *Agricultural hydrology, *Evapotranspiration, *Water stress, *Soil-water-plant relationships, *Water deficit, Available water, Model studies, Soil water, Plant growth.

The influence of crop water environment on the productivity of no-till winter wheat (Triticum aestivum L. 'Norstar') was observed for 17 site-years of trials in Saskatchewan between 1984 and 1986. Growing season precipitation (P) averaged 212 mm (approximately 120% of average) and pan evaporation (E) averaged 749 mm for these trials. Precipitation was approximately evenly distributed across the growing season while E increased from a low of 6.5 mm/d in early May to a high of 8.3 mm/d immediately after anthesis. Consequently, water stress was highest after anthesis. Total evapotranspiration (ET) (soil water use to 130 cm plus growing season P) ranged from 171 to 364 mm and approximately 20% of the eT was derived from soil water reserves. The average ratio of ET before and after anthesis was 1:7:1 and in many instances water utilized after anthesis was almost exclusively derived from intermittent rainfall events. Several yield-water models were fit to the data in order to establish a relationship between the crop water environment and grain yield. Yields ranged from 1316 to 5003 kg/ha and were most closely associated with the water environment (soil water, E and P) during the time from stem elongation to anthesis (r squared = 0.71). Water use efficiency, expressed as kg/ha grain yield divided by ET, ranged from 6.3 to 18.8 kg/ha-mm and was positively correlated with spikes/sq m (r = 0.59), kernel weight (r = 0.73), dry matter at anthesis (r = 0.84), and negatively correlated with E during the 30 days prior to anthesis (r = 0.75). Both dry matter at anthesis and dry matter at maturity were linearly correlated with grain yield (r = 0.85 and 0.92, respectively). Both observations suggested that high grain yields required high dry matter yields. (Author's abstract)
W89-12366

EFFECT OF CROP ROTATION AND FERTILIZATION ON THE QUANTITATIVE RELATIONSHIP BETWEEN SPRING WHEAT YIELD AND MOISTURE USE IN SOUTHWESTERN SASKATCHEWAN.
Agriculture Canada, Swift Current (Saskatchewan). Research Station.
For primary bibliographic entry see Field 3F.
W89-12432

DIFFERENTIAL GENOTYPIC RESPONSE TO DROUGHT STRESS AND SUBSOIL ALUMINUM IN SOYBEAN.
Wisconsin Univ.-Madison. Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W89-12437

DROUGHT EFFECT ON LEAF CONDUCTANCE AND LEAF ROLLING IN FORAGE GRASSES.
Agriculture Canada, Agassiz (British Columbia). Research Station.
S. Bittman, and G. M. Simpson.
Crop Science CRPSAY, Vol. 29, No. 2, p 338-344, March-April 1989. 5 fig, 4 tab, 35 ref.

Descriptors: *Water loss, *Drought, *Leaves, *Conductance, *Forages, Seasonal variation, Grasses, Wheatgrasses, Hydrological regime, Soil types, Water potentials.

Control of water loss is essential for plants growing in the northern Great Plains. The objectives of this study were to examine seasonal changes in leaf conductance of three forage grasses, smooth bromegrass, Altai wildrye, and crested wheatgrass, growing under contrasting water regimes to relate changes in leaf conductance to leaf water status, and to examine the relationship between leaf rolling response and leaf water status in crested wheatgrass. The study was conducted on deep black soil at Melfort, Saskatchewan. Rainout shelters and irrigation were used to impose two contrasting water regimes. Altai wildrye generally had higher leaf conductance than the other two species, while smooth bromegrass had low leaf conductance early in the season when its leaf water potential was high. Under favorable moisture, crested wheatgrass had lowest proportion of conductance from abaxial surface among the species, although abaxial conductance in smooth bromegrass and Altai wildrye declined more rapidly than adaxial conductance under drought. Much of the variation in leaf conductance was not accounted for by leaf water potential in all three species. Leaf conductance also changed gradually with leaf pressure potential over a wide range of leaf pressure potential values, particularly in the mornings. In contrast, leaf rolling in crested wheatgrass was strongly related to both leaf water potential and leaf pressure potential. The data suggest that other factors such as the rate of leaf water loss affect stomatal response to tissue water loss. (Author's abstract)
W89-12438

SIMULATION MODEL FOR STUDYING PHYSIOLOGICAL WATER STRESS RESPONSES OF WHOLE PLANTS.
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
K. J. McCree, and C. J. Fernandez.
Crop Science CRPSAY, Vol. 29, No. 2, p 353-360, March-April 1989. 7 fig, 3 tab, 16 ref.

Descriptors: *Simulation, *Water stress, *Plant physiology, *Soil-water-plant relationships, *Model studies, *Water deficit, Photosynthesis, Respiration, Conductance, Stomata, Leaves, Growth, Carbon dioxide, Salinity, Carbon, Irrigation, Roots.

Simulation models are useful tools for integrating ideas about physiological responses to soil water deficits at the whole plant level. A model that mimics the behavior of plants exposed to a single cycle of water deficit under controlled environment conditions uses linear functions to describe the following basic physiological responses to soil water: (1) rate of new leaf production, (2) stomatal closure, (3) rate of senescence as it affects stomatal conductance, photosynthetic and respiratory rates, and leaf area. Simulations with the model demonstrated how the assumption of a hyperbolic dependence of photosynthetic rate on internal CO2 concentration could lead to an increase in water

use efficiency as stomates close. The model confirmed published data showing that stomatal closure induced by salinization increases the efficiency under water stress and leads to a greater C gain per irrigation cycle. Other simulations demonstrated how an increase in the volume of soil explored by unit mass of new roots could lead to greater amounts of water uptake and C gain per cycle. Interactions among these and other factors can be studied in a way that would not otherwise be possible. (Author's abstract)
W89-12439

INFLUENCE OF WATER MANAGEMENT ON GROWTH AND YIELD OF NO-TILL PLANTED RICE.
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
S. M. Dabney, and B. J. Hoff.
Crop Science CRPSAY, Vol. 29, No. 3, p 746-752, May-June 1989. 3 tab, 30 ref.

Descriptors: *Irrigation management, *Water stress, *Sprinkler irrigation, *Rice, *Crop yield, Growth, Productivity, Tensiometers, Monitoring, Irrigation, Flood irrigation, Seeds, Plant diseases, Biomass, Evapotranspiration.

To determine the feasibility of producing rice on lands equipped with sprinkler-irrigation systems, the productivity of flood-irrigated rice was compared with that of rice grown under two levels of sprinkler irrigation on a Mhoon silty clay from 1984 to 1986. Two high-quality cultivars, 'Labelle' and 'Lemont,' were compared with 'CICA-8,' one of the most productive cultivars on favored upland sites in Latin America. Soil matric potential was monitored daily with tensiometers placed at 15-cm and 30-cm soil depths. Beginning 30 d after no-till drill planting into a killed legume cover crop, rice was flood-irrigated or sprinkler-irrigated when soil matric potential at either depth fell below -20 or -50 kPa. Each cultivar matured later and yielded less, as a result of reduced numbers of seed per panicle and reduced seed weight, when grown under sprinkler irrigation compared with flooded culture. In years without severe disease, Lemont and CICA-8 yields were reduced 10 to 25% from the 5000 to 6700 kg/ha produced under flood, while Labelle yield was reduced 27 to 56%. During 1986, rotten-neck blast reduced yields of all cultivars grown under sprinkler-irrigated conditions by 60 to 80%. Biomass production and yield differed between the two levels of sprinkler irrigation only when precipitation plus irrigation was less than potential evapotranspiration (PE). It is concluded that no level of sprinkler irrigation can completely eliminate water stress in upland rice when PE is high. (Author's abstract)
W89-12440

MODEL OF THE PHOSPHORUS DYNAMICS OF CALLUNA HEATHLAND.
Institute of Terrestrial Ecology, Wareham (England). Furzebrook Research Station.
S. B. Chapman, R. J. Rose, and R. T. Clark.
Journal of Ecology JECOAB, Vol. 77, No. 1, p 35-48, March 1989. 8 fig, 2 tab, 35 ref.

Descriptors: *Cycling nutrients, *Phosphorus, *Soil chemistry, *Heathlands, *Model studies, Land management, Vegetation, Leaching, Incineration, Adsorption.

The nutrient dynamics of heathland were studied with emphasis on the examination of data from a dynamic and functional perspective rather than a static or budget angle. The model PCAL was used to examine the long-term consequences of management techniques, and the importance of specific factors in the phosphorus economy of Calluna heathlands. PCAL is controlled by the intrinsic growth of the vegetation, simulated by the Gompertz function, but limited by availability of inorganic phosphorus in the soil, and operates by either annual or monthly time steps. As vegetation cover develops, so organic matter accumulates within the root zone, and mineral phosphorus present in the parent sand material comes into solution. During this stage the adsorption capacity of the soil is insufficient to hold all the phosphorus that is released and there is a constant loss by leaching. As the vegetation develops, so incorporation of phosphorus into the root and soil organic matter increases, until a stage is reached where losses by leaching occur only after heath fires. The most important implications of the model center on the adsorption capacity of the soil system and variations in the levels of available soil phosphorus upon primary production. The phosphorus adsorption capacity of the soil is important when considering the effect of heather burning upon heathland management. In cases where the adsorptive capacity is low, the soil is unable to hold all of the phosphorus that is liberated on burning, and a proportion of the soluble phosphorus may be lost in drainage water. Heathland vegetation is well adapted to survive on low phosphorus soils. As only low levels of inorganic phosphorus can be held within the soil it is advantageous for accumulation and slow release to take place within the organic components of the system. (White-Reimer-PTT)
W89-12501

WOODY SEEDLING DYNAMICS IN AN EAST TEXAS FLOODPLAIN FOREST.
Rice Univ., Houston, TX. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-12677

SOME RELATIONSHIPS BETWEEN PLANT GROWTH AND SOIL MOISTURE VARIATIONS.
Kagoshima Univ. (Japan). Lab. of Tropical Crops.
A. Sumi.
Memoirs of the Faculty of Agriculture, Kagoshima University MAKUA6, Vol. 25, pp. 39-51, March 1989. 14 fig, 11 ref.

Descriptors: *Soil water, *Soil-water-plant relationships, *Plant growth, Evapotranspiration, Soybeans, Sorghum, Water requirements.

Soybean and sorghum plants were grown under various types of soil moisture variations. The effects of soil moisture variation upon growth increment, evapotranspiration and water requirement were examined. Although growth under greater soil moisture variation tended to be smaller than that under less variation in all the mean soil moisture plots, no significant difference was seen until the range of soil moisture variation was greater than 30 percent. Evapotranspiration was significantly smaller when soil moisture variation became greater than 30 percent and the mean soil moisture ratio and the range of soil moisture variation was 21.3%. The effect of soil moisture variation upon water requirement did not appear to be important. It is concluded that mean soil moisture ratio was valid, to a certain extent, in the relationships of plant growth, evapotranspiration and water requirement with the soil moisture conditions, except under extreme soil moisture variations. (Mertz-PTT)
W89-12776

EARLY GROWTH IN SORGHUM PLANT UNDER COMBINED TREATMENTS OF SOIL MOISTURE AND CALCIUM PHOSPHATE APPLICATION.
Kagoshima Univ. (Japan). Lab. of Tropical Crops.
A. Sumi.
Memoirs of the Faculty of Agriculture, Kagoshima University MAKUA6, Vol. 25, pp. 53-63, March 1989. 9 fig, 1 tab, 14 ref.

Descriptors: *Sorghum, *Soil water, *Soil-water-plant relationships, *Plant growth, *Calcium compounds, *Phosphorus compounds, Calcium phosphate, Evapotranspiration, Transpiration, Dry matter, Synergistic effects.

The sorghum cultivar Sorghum-Sudan Hybrid was grown in 25 13-liter seedling culture boxes, under soil moisture treatments. Five replicates of each moisture treatment were subjected to different concentrations of calcium phosphate. Growth increased hyperbolically with increase in the soil moisture ratio and the amount of calcium phosphate applied. Deficiencies of soil moisture and the calcium phosphate affected not only dry matter production, but also the distribution of dry matter. These two factors appear to be interactive. The results suggest that the influences of these two factors upon water use efficiency were small, and there was a close connection between mechanisms affecting dry matter production and transpiration. (Mertz-PTT)
W89-12777

DROUGHT EFFECTS ON WATER RELATIONS OF THREE CULTIVATED GRASSES.
Agriculture Canada, Regina (Saskatchewan). Research Station.
S. Bittman, and G. M. Simpson.
Crop Science CRPSAY, Vol. 29, No. 4, p 992-999, 1989. 4 fig, 4 tab, 29 ref.

Descriptors: *Grasses, *Cultivation, *Forages, *Soil-water-plant relationships, *Soil water potential, *Plant water potential, *Drought resistance, Irrigation effects, Irrigation requirements, Leaves, Osmosis, Membrane processes, Water requirements, Growth kinetics, Wheatgrasses, Bromegrass, Environmental control, Environmental effects, Great Plains.

Water is the predominant environmental factor controlling yield of forages in the northern Great Plains. This study was conducted to compare the effects of contrasting soil water regimes on the water relations of smooth bromegrass, crested wheatgrass, and Altai wildrye. The grasses were grown on deep black soil under two soil water regimes: DRY plots were covered by rainout shelters beginning at the end of May and IRR plots were watered when soil potential averaged -0.07 megapascals. Measurements of soil water potential, leaf water potential, osmotic potential, and relative water content were taken periodically during first and second growths in 1983 and 1984. Crested wheatgrass generally had lower leaf water potential and relative water content than smooth bromegrass or Altai wildrye. At a specific soil water potential, leaf water potential of crested wheatgrass was 0.3 to 0.7 megapascals lower than that of smooth bromegrass, possibly resulting from small xylem vessels in crested wheatgrass. Osmotic adjustment in crested wheatgrass and smooth bromegrass was similar, but crested wheatgrass lost more water for a change in pressure potential, which helped it maintain pressure potential. Differences in water relations reflected growth patterns and drought resistance strategies previously reported for these species. (Author's abstract)
W89-13135

WATER UPTAKE BY COTTON ROOTS DURING FRUIT FILLING IN RELATION TO IRRIGATION FREQUENCY.
Agricultural Research Service, Phoeniz, AZ. Western Cotton Research Lab.
J. W. Radin, J. R. Mauney, and P. C. Kerridge.
Crop Science CRPSAY, Vol. 29, No. 4, p 1000-1005, 1989. 5 fig, 2 tab, 33 ref. BARD Grant I-467-82.

Descriptors: *Roots, *Drip irrigation, *Soil-water-plant relationships, *Irrigation practices, *Cotton, Plant water potential, Plant growth, Irrigation requirements, Hydraulic conductivity, Crop production, Leaves, Fruit crops, Soil water, Transpiration ratio, Regression analysis, Water stress, Roots, Arizona.

Yield of irrigated cotton increases as the interval between water applications is decreased, even if the total amount of water applied is unchanged. Experiments were undertaken to compare season-long water relations of high-frequency drip-irrigated cotton (one-to-two-day intervals) to cotton irrigated at approximately two-week intervals. The crop was grown at two locations in central Arizona on a Mohall sandy loam and an Avondale clay loam. In two-year trials at each location, irrigation frequency had inconsistent effects on midday leaf water potential during vegetative growth. When the crop developed a heavy fruit load, however, leaf water potential of plants on the longer cycles was much lower than that of drip-irrigated plants,

even after irrigation when ample soil moisture should have been available. Plant hydraulic conductances, estimated from regressions of single-leaf transpiration rate against leaf water potential, were high in both treatments early in the season. Hydraulic conductance decreased greatly during fruiting in plants on long irrigation cycles but less so in drip-irrigated plants. Late in the season, after fruit maturation and during plant regrowth, conductances were again high and similar in the two treatments. The results imply that during heavy fruiting, mild water stress associated with long irrigation cycles triggers deterioration of the root system that is very slow to be reversed. High-frequency drip irrigation, by preventing cyclical stress, apparently minimized this deterioration during fruit filling. (Author's abstract)
W89-13136

2J. Erosion and Sedimentation

SEDIMENT AND NUTRIENT LOSSES FROM AN UNIMPROVED, ALL-YEAR GRAZED WATERSHED.
Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed.
L. B. Owens, W. M. Edwards, and R. W. VanKeuren.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 232-238, April/June 1989. 6 fig, 5 tab, 22 ref.

Descriptors: *Soil erosion, *Nutrient removal, *Agricultural watersheds, *Grazing, Sediments, Streams, Nutrients, Watersheds, Potassium, Calcium, Magnesium, Sodium, Chlorine, Cattle, Ohio, Water quality.

A common practice for grazing land in the humid, eastern United States is continuous grazing with little or no fertilizer use. Concentrations and transport of nutrients from a 28-ha unimproved grassed watershed were assessed in east-central Ohio for 2 years without the presence of livestock, for 3 years with a 17-cow beef (Bos taurus) herd grazing during the summer months only, and for an additional 6 year period with all year grazing with hay being brought in for the winter feed. Nutrient concentrations remained low during all three grazing levels. An exception was K concentration which increased with all-year grazing. Concentrations of NO3-N, mineral-N, Ca, Mg, Na, and Cl were similar to or less than the concentrations from a nearby 17.7 ha wooded watershed that contained no pastured areas and received no agricultural inputs. Nutrient concentrations showed no consistent seasonal variations. Concentrations of organic-N, total organic C and sediment increased with increased grazing pressure. Greatest sediment concentrations and transport rates generally occurred during July and August regardless of grazing systems. Largest monthly average sediment concentrations were 0.8, 1.3, and 3.2 g/L for the three systems, respectively; annual sediment losses were 0.2, 1.2, and 2.1 Mg/Ha, respectively. All-year cattle grazing/feeding on an unimproved pasture in this area would not be expected to produce degradation of stream water quality from nutrient concentrations or transport. (Author's abstract)
W89-12186

TEMPORAL VARIATION IN NITRATE AND NUTRIENT CATIONS IN DRAINAGE WATERS FROM A DECIDUOUS FOREST.
Great Lakes Forestry Research Centre, Sault Sainte Marie (Ontario).
For primary bibliographic entry see Field 5C.
W89-12187

METHODOLOGICAL FUNDAMENTALS IN STUDYING SEDIMENTATION IN RESERVOIRS–A SURVEY (METODOLOGICHESKIE OSNOVY IZUCHENIYA SEDIMENTATSII V VODOEMAKH) (OBZOR).
Akademiya Nauk Armyanskoi SSR, Sevan. Hydrobiological Station.
L. O. Glushchenko.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 2, p 68-76, 1988. 1 fig, 1 tab, 39 ref. English summary.

Descriptors: *Sedimentation, *Sediment sampler, *Reservoirs, Instrument design, Data acquisition.

The fundamental principles governing the operation of sediment traps in water bodies are presented. Factors affecting the validity of estimating the flow of the sedimenting particles under natural conditions are considered. The basic sediment trap design requirements to collect sedimenting substances are as follows: for cylindrical shape, the cylinder height/diameter ratio >5 under D>45 mm. The periods of trap exposure in the water must be minimized to 1 to 3 days. (Author's abstract)
W89-12283

MICROHETEROTROPHIC ACTIVITY IN A SUBANTARCTIC INTERTIDAL SEDIMENT RELATIVE TO NUTRIENT SUPPLY.
Centre de Recherches Oceanographiques, Abidjan (Ivory Coast).
M. Bouvy.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 2, p 245-255, April 1989. 2 fig, 1 tab, 55 ref.

Descriptors: *Heterotrophic bacteria, *Intertidal areas, *Marine sediments, *Limiting nutrients, *Marine bacteria, *Antarctic, *Mud flats, *Respiration, *Mineralization, Carbon radioisotopes, Substrates, Glucose, Amino acids, Seasonal variation, Water temperature, Kerguelen Islands, Aquatic bacteria, Intertidal sediments, Organic matter, Subantarctic, Metabolism, Absorbtion, Bacterial physiology.

Microbial uptake and respiration (mineralization) with C14-labeled glutamic acid and glucose were studied over a year with a sampling every week in an intertidal muddy sediment located in the subantarctic zone (Kerguelen archipelago). The rate at which the test substrate was incorporated into cell material plus that respired as CO2 was used to calculate the relative microbial activity (total uptake). Organic matter supplies were directly linked to the temperature. Obvious seasonal variations in the relative activity and respiration percent were noted for both substrates. Significant positive linear correlations were observed between glucose and glutamic acid total uptake with maximum values during the winter (close to 50% and 30%, respectively). Negative correlations between bacterial heterotrophic activities and other parameters such as temperature, organic matter concentration and bacterial abundance were observed. All these physiological responses suggest that deficiencies of available organic nutrient in winter are responsible for the 'stress' of the natural heterotrophic microbial communities. (Author's abstract)
W89-12290

SURFACE SUBLITTORAL SEDIMENTS OF FLORIDA BAY.
Royal Holloway and Bedford New Coll., Egham (England). Dept. of Geology.
D. Bosence.
Bulletin of Marine Science BMRSAW, Vol. 44, No. 1, p 434-453, January 1989. 14 fig, 1 tab, 18 ref.

Descriptors: *Florida Bay, *Reviews, *Marine sediments, *Estuaries, *Sedimentation, *Sedimentary structures, Coastal marshes, Mud flats, Bottom sediements, Lake sediments, Banks.

Previous work on the surface sediments of Florida Bay are reviewed. A detailed analysis was conducted of sediments from the restricted Cross Banks area and the more open marine Buchanan Keys area. Sediments of the Cross Banks area are composed principally of mollusk and foraminifer grains with a pelleted, silt-sized matrix. Textures on the banks vary from windward mud-pebble-conglomerates, packstones and grainstones to bank-top leeward, and lake, wackestones and mudstones. The mudstones deposited in patchy to dense seagrass beds. Sediments of the Buchanan Banks area comprise grains of Halimeda, coral and lithoclasts in addition to mollusk and foraminifera grains. Windward facies are packstones, grainstones and some Porites framestones. Bank top and leeward margins accumulate peloidal mudstones and wackestones under seagrass cover. Lake floors have a thin packstone covering. In both areas, facies consistently occur as bands paralleling the bank margins. Sedimentary structures, textures, seagrass rhizome depths and measurements of changes in bank morphology all indicate windward erosion and leeward deposition and mound sediment. This supports recent hypotheses of downwind bank migration, and suggests that this occurs in normal but sporadic weather conditions. When surface sediment composition and benthic communities are compared regionally within south Florida, they show a trend of reducing diversity from the reef tract through to central Florida Bay. Sediment textures vary locally with windward and leeward environments but show few regional trends in their occurrence. (See also W89-12363) (Author's abstract)
W89-12364

ORIGIN, GROWTH AND EVOLUTION OF CARBONATE MUDBANKS IN FLORIDA BAY.
Rosenstiel School of Marine and Atmospheric Science, Miami, FL. Div. of Marine Geology and Geophysics.
For primary bibliographic entry see Field 2L.
W89-12365

TOWARD A MODEL FOR OPEN-BASIN AND CLOSED-BASIN DEPOSITION IN ANCIENT LACUSTRINE SEQUENCES: THE NEWARK SUPERGROUP (TRIASSIC-JURASSIC), EASTERN NORTH AMERICA.
Emory Univ., Atlanta, GA. Dept. of Geology.
P. J. W. Gore.
Palaeo PPPYAB, Vol. 70, No. 1-3, p 29-51, April 1989. 10 fig, 100 ref. National Geographic Society grant 3008-84.

Descriptors: *Sedimentation, *Paleohydrology, *Paleoclimatology, *Lake sediments, *Geologic units, *Sedimentology, Lakes, Fluctations, Geologic history.

Climate and tectonics have a profound influence on the lacustrine sedimentary record because they affect hydrologic systems in depositional basins. Lakes in hydrologically-closed basins tend to fluctuate in depth, producing transgressive-regressive sequences, sometimes associated with evaporites. Lakes in hydrologically-open basins tend to have stable shorelines, producing thick sedimentary deposits that lack transgressive-regressive sequences and evaporites. In addition, some lakes fluctuate between open and closed, producing transgressive-regressive sequences in which deep water sediments were deposited when the lake was overflowing, and shallow water sediments capped by subaerial exposure surfaces were deposited when the basin was closed. Lacustrine deposits in the northern part of the Newark Supergroup consist of cyclic transgressive-regressive sequences, locally containing evaporites. They are interpreted as deposits of hydrologically-closed basins, which occasionally became open at lake high-stand. In the southern part of the Newark Supergroup, many of the lacustrine sequences are thicker, lack evaporites, and some contain coal and siderite. These features suggest deposition in hydrologically-open basins. Fluvial paleocurrents in at least one southern basin suggest throughflow and open basin deposition. Thin lacustrine sequences interpreted as perennial floodplain lake deposits are associated with these fluvial systems, and may also indicate open basin conditions. (Author's abstract)
W89-12375

FACIES RELATIONSHIPS AND SEDIMENTATION IN LARGE RIFT LAKES AND IMPLICATIONS FOR HYDROCARBON EXPLORATION: EXAMPLES FROM LAKES TURKANA AND TANGANYIKA.
Arizona Univ., Tucson. Dept. of Geosciences.
A. S. Cohen.
Palaeo PPPYAB, Vol. 70, No. 1-3, p 65-80, April 1989. 4 fig, 2 tab, 58 ref.

Descriptors: *Sedimentology, *Sedimentation, *Lake sediments, *Geologic formations, *Stratigraphy, *Geologic units, Geologic history, Geomorphology, Drainage basins, Lake Tanganyika, Lake Turkana.

Two African lakes, Tukana and Tanganyika, illustrate a spectrum of sediments and facies architectures which can occur in large rift lacustrine basins. They demonstrate contrasts between sediments deposited in a semi-arid, moderately deep, mainly volcanic basin (Turkana) and a semi-humid, extremely deep basin without significant volcanism (Tanganyika). Turkana deposits are dominated by rapidly accumulating, organic-poor, terrigenous muds. Coarse-elastic input is in part limited by ponding in marginal subbasins due to volcanic barriers. Profundal coarse-clastic deposition is rare. Sediments contain little biogenic components except in the sediment-starved south basin. Sediments are also poor in carbonates. Tanganyika deposits are dominated by organic rich, biogenic muds. Steep fault-escarpments and uniform slopes along shelf platform and rift-axis lake margins promote the efficient transport of sands into profundal settings. Total clastic sediment supply into the basin is severely restricted by basin morphology with steep relief, backsloping, a limited drainage basin area and presettling in upstream Lake Kivu. Sediment ponding along margins is rare. Littoral carbonates are common, a consequence of low net clastic sedimentation rates. Many of the differences between facies in the two lakes can be explained by contrasts in basin margin slope and relief, volcanic activity, and climate between the two lakes. The results of this study suggest that lake deposits formed in Tanganyika-type rift basins are more appropriate exploration targets for hydrocarbon exploration than those from Turkana-type basins. (Author's abstract)
W89-12376

QUATERNARY LAKES OF ARGENTINA.
Consejo Nacional de Investigaciones Cientificas y Tecnicas, Buenos Aires (Argentina).
For primary bibliographic entry see Field 2H.
W89-12377

HYDROGEN INDEX AND CARBON ISOTOPES OF LACUSTRINE ORGANIC MATTER AS LAKE LEVEL INDICATORS.
Bergen Univ. (Norway). Dept. of Geology.
For primary bibliographic entry see Field 2H.
W89-12378

METHANE PRODUCTION, SULFATE REDUCTION AND COMPETITION FOR SUBSTRATES IN THE SEDIMENTS OF LAKE WASHINGTON.
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 2K.
W89-12401

BED-SURFACE SIZE CHANGES IN GRAVEL-BED CHANNEL.
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
R. A. Kuhnle.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 6, p 731-743, June 1989. 8 fig, 4 tab, 17 ref, append.

Descriptors: *Channel morphology, *Sediment sorting, *Sediment transport, *Gravel, *Channels, *Streambeds, Equilibrium, Flumes, Sediments, Sumps, Particle size, Shear stress, Friction, Turbulent flow, Channel morphology.

Equilibrium sediment transport experiments were made in two flumes, one with a 6-m-long by 0.15-m-wide channel and the other with an 11-m-long and either 0.74-m-wide or 0.53-m-wide channel. The sediment (0.1 to 32 mm, D sub 50 = 3.03 mm) was fed at the upstream end of the channel and was trapped in the sump at the downstream end. For the runs of this study, the bed-surface grain size became finer and the sediment transport rate increased as the total bed shear stress decreased slightly and then increased. This decrease in bed shear stress was probably caused by the varying coarseness of the bed surface. In the runs with higher transport rates, the bed surface was finer, so bed shear stresses were lower. The difference in friction factors (determined from the Moody diagram for rough turbulent flow) for D sub 65 of the bed surface sediment and D sub 65 of the original sediment mix (or of the sediment in transport) was used to represent the extra friction factor due to roughness changes. Subtracting this quantity from the bed friction factor allowed the calculation of an effective shear stress available for sediment transport. The relation of sediment transport rate and bed-surface grain size to shear stress was improved by using the effective shear stress rather than the total shear stress. (Author's abstract)
W89-12412

UNIVERSAL BANK EROSION COEFFICIENT FOR MEANDERING RIVERS.
Hokkaido Univ., Sapporo (Japan). Dept. of Civil Engineering.
K. Hasegawa.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 6, p 744-765, June 1989. 10 fig, 2 tab, 18 ref, append.

Descriptors: *Bank erosion, *Rivers, *Meanders, *Erosion rates, Channels, Soil types, Sand, Clays, Mathematical analysis, Scour, Flow characteristics, Maps.

An equation for bank erosion, and thus channel migration rate, was derived theoretically from the equation of sediment continuity. The relation so derived lends credence to the hypothesis that bank erosion is proportional to a near-bank 'excess' velocity, defined to be the difference between near-bank and centerline depth-averaged streamwise flow velocity. The theory also leads to the definition of a coefficient of bank erosion of a general nature. Based on data for channel shift for several Japanese rivers, it could be concluded that the universal erosion coefficient decreases as the index (number of blows) of the standard penetration test, as applied to the river bank, increases. Two trends appear, however, depending on whether or not bank texture is sandy or clayey. The curve displaying the higher erosion rate corresponds to banks in which sand and gravel dominate; for clayey beds, the curve yields lower erosion rates. The erosion rate tends to be modest when the bed material adjacent to the bank is very fine or very coarse, but becomes largest for the case where the adjacent bed material is medium to coarse sand. (Doria-PTT)
W89-12413

MODELING MIXED SEDIMENT SUSPENDED LOAD PROFILES.
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
B. Morse, and R. D. Townsend.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 6, p 766-780, June 1989. 8 fig, 1 tab, 20 ref, append. Natural Sciences and Engineering Research Council of Canada Grant A7443.

Descriptors: *Model studies, *Sediment transport, *Error analysis, *Suspended load, Profiles, Vertical distribution, Particle size, Sediments, River flow, Shear, Fall velocity.

Potential errors in calculated vertical suspended sediment concentration profiles in river flows carrying mixed sediments were investigated. These profiles are usually obtained through application of a standard 'diffusion-dispersion' model; however, such models are normally formulated on the basis of a unique grain size for the sediment. In the case of sediment mixtures, the grain size distribution is usually divided into several size ranges ('fractions'), which are then characterized by their respective geometric means. Numerical errors induced through this procedure are quantified in a parametric study. While depth-averaged concentrations can be over-estimated by a factor of 1.2 when the concentration gradient is weak, they can be under-estimated by a factor of 15 when the gradient is large. Estimates are particularly sensitive when the chosen reference level is small and the fraction width is large. Fall velocity coefficients were introduced to correct the discrepancy between the actual representative fall velocity of a fraction and that of the geometric mean size of the fraction. (Author's abstract)
W89-12414

TURBULENCE CHARACTERISTICS OF SEDIMENT-LADEN FLOW.
Tsinghua Univ., Beijing (China). Sediment Research Lab.
For primary bibliographic entry see Field 2E.
W89-12415

MOBILE-BED FRICTION AT HIGH SHEAR STRESS.
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
K. C. Wilson.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 6, p 825-830, June 1989. 1 fig, 10 ref, append.

Descriptors: *Sediment transport, *Hydraulic roughness, *Channel morphology, *Streambeds, *Friction, *Shear stress, Sand, Mathematical analysis, Viscosity, Particle size, Bed load, Roughness coefficient, Hydraulics.

An analysis demonstrated, and experimental results confirmed, that the friction behavior of mobile beds at high shear stress is inherently different from either of the two classical cases, smooth-wall and rough-wall. For those two cases, the characteristic lengths for friction are based on viscosity and grain size, respectively. For the new mobile-bed friction relation, this length varies with the thickness of the shear layer occupied by the moving bed-load particles. This thickness is itself directly related to shear stress, giving rise to the prediction that at high shear stress (Shields ordinate greater than unity) the effective roughness ratio (effective roughness/particle diameter) should be approximately five times the Shields ordinate. It is often assumed that the effective roughness ratio has a virtually constant value, but the high-shear-stress experimental results show clearly that this ratio increases in accord with the prediction. (Doria-PTT)
W89-12418

APPLICATION OF LOW-ENERGY SOURCE SEISMIC REFRACTION TO INVESTIGATION OF UNCONSOLIDATED SEDIMENTS, NEGRIL BEACH, JAMAICA.
University of the West Indies, Kingston (Jamaica). Dept. of Geology.
For primary bibliographic entry see Field 7B.
W89-12460

ESTIMATION OF SILTATION OF THE TEREBLYA-RIKA HYDROELECTRIC STATION RESERVOIR.
A. Y. Kuznets, A. N. Kaftan, V. V. Onishchuk, and A. S. Bilchuk.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 7, p 437-441, January 1989. 3 fig, 1 tab, 8 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 7, p 47-50, July 1988.

Descriptors: *Reservoir silting, *Hydroelectric plants, *Sedimentation, Suspended load, Sediment-carrying capacity, Hydrographs, Sediment transport, Statistical analysis, Stream discharge, Dams, USSR.

The development of methods of calculating and predicting siltation of reservoirs is acquiring great significance in the practice of constructing small and medium multipurpose hydroelectric developments. The absence of reliable data on the sediment load of mountain rivers and insufficient observations at operating reservoirs do not permit at present a well-founded calculation of the duration of functioning of reservoirs. An analysis of the combined profiles for the 1958, 1966, 1976, and

1986 observations of siltation of the Terebliya-Rika hydroelectric station showed that considerable deformations of the reservoir bed did not occur near the hydrostation dam and its intake. An estimation of the suspended-load discharge with the use of the existing data of hydrological yearbooks was not reliable, since it gave quite underestimated results of the calculation in comparison with the actual volumes of siltation of the reservoir. The bed-load discharge calculated on the basis of data on the migration of meso-forms and a detailed analysis of the actual maximum runoff hydrographs of the Terebliya River, characterized by the transport of channel-forming sediments, is in good agreement with the data of the particle-size analysis of the reservoir siltation products and amounts to not more than 1% of the total sediment load. On the basis of a statistical analysis of the data of field observations, a lognormal relation was established between the volumes of water and sediment discharges, reflecting the main characteristics of fluvial processes of streams in the investigated region. With consideration of the substantial changes in the morphometric characteristics of the reservoir, it is economically advisable to change to the use of refined depth curves. (Fish-PTT)
W89-12471

EROSION CONTROL STRATEGIES FOR BAY AND ESTUARINE BEACHES.
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
For primary bibliographic entry see Field 4D.
W89-12496

AQUATIC SEDIMENTS.
URS Consultants, Inc., Cleveland, OH. Planning and Environmental Services Div.
For primary bibliographic entry see Field 5A.
W89-12542

PERENNIALLY ICE-COVERED LAKE HOARE, ANTARCTICA: PHYSICAL ENVIRONMENT, BIOLOGY AND SEDIMENTATION.
Nevada Univ., Reno. Desert Research Inst.
For primary bibliographic entry see Field 2H.
W89-12570

STUDIES OF ESTUARINE SEDIMENT DYNAMICS USING 137CS FROM THE TJERNOBYL ACCIDENT AS A TRACER.
Umea Univ. (Sweden). Dept. of Physical Geography.
L. Brydsten, and M. Jansson.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 3, p 249-259, March 1989. 4 fig, 3 tab, 5 ref.

Descriptors: *Chernobyl accident, *Fallout, *Lake sediments, *Radioactive tracers, *Path of pollutants, *Nuclear powerplants, *Cesium radioisotopes, *Sediment transport, *Estuaries, Tracers, Suspended load, Particulate matter, Sediment distribution, Sweden, Storms.

In late April 1986, the whole catchment area of the River Ore in the province of Vasterbotten, Northern Sweden, was affected by precipitation contaminated with radionuclides from the nuclear power plant accident in Chernobyl, U.S.S.R. Sediment dynamics in the Ore River estuary were studied by monitoring the turnover of particles associated with 137Cs in surface sediment and sediment traps during the period following the accident from late April to late November, 1986. It was found that river transported material was deposited in the estuary and then frequently redistributed due to resuspension-redeposition processes during the ice-free period. There was a slow net transport of particles out of the estuary that was delayed by at least one event with a significant particle redistribution to the inner part of the estuary following a storm in late autumn; if this is a regular phenomenon, this type of event will increase the residence time of particles within the estuary. Wind and wave-induced water dynamics are responsible for resuspension and transport of particles. The internal sediment dynamics, i.e., resuspension-redistribution within the estuary are much more intense compared with the rates of input and output of particles. (Friedmann-PTT)
W89-12603

CARBON ISOTOPES AND FATTY ACIDS ANALYSIS OF THE SEDIMENTS OF NEGRO HARBOUR, NOVA SCOTIA, CANADA.
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
C. G. LeBlanc, R. A. Bourbonniere, H. P. Schwarcz, and M. J. Risk.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 3, p 261-276, March 1989. 7 fig, 4 tab, 28 ref.

Descriptors: *Chemical analysis, *Marine sediments, *Estuaries, *Nova Scotia, *Canada, *Carbon isotopes, *Fatty acids, *Lipids, *Sediment transport, Indicators, Geologic history, Organic compounds, Carbon.

Fatty acid (FA) ratios are intercalibrated with stable isotopes (lambda13C) to characterized the sediments of a Nova Scotian estuary that receives mixed terrestrial input (peat, higher plants). Salinity records indicate a stronger river influence in 1985 compared to 1984. The isotopic signature in the sediments is in contradiction with these records implying a lesser terrestrial input in 1985. Total (%) organic carbon (TOC) and fatty acid concentrations were higher in 1985. The C24/C14 and C24/C16 fatty acid ratios both agree with the salinity records. Percentages of terrestrial organic matter in the sediments, calculated from both isotopes and fatty acid ratios through a mixing equation, decreased seaward as expected. Both FA ratios give essentially the same percentage terrestrial organic carbon at each site. Percentages calculated from lambda13C and fatty acid ratio are similar at least in the upper part of the estuary. However, changes in the relative contribution of peat compared to higher terrestrial plants are more readily noticed using fatty acid ratios than with isotope ratios. (Author's abstract)
W89-12604

FLUX OF PARTICULATE ALUMINUM ACROSS THE SOUTHEASTERN U.S. CONTINENTAL SHELF.
Skidaway Inst. of Oceanography, Savannah, GA.
H. L. Windom, and T. F. Gross.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 3, p 327-338, March 1989. 8 fig, 1 tab, 11 ref. DOE grant DE-FG09-86ER60435.

Descriptors: *Coastal waters, *Advection, *Sediment transport, *Sedimentation, *Saline-freshwater interfaces, *Aluminum, *Particulate matter, *Continental shelf, Spatial distribution, Model studies, Particle size, South Atlantic Bight, Nearshore process.

The concentration of particulate aluminum was determined across the coastal boundary front and the continental shelf of the South Atlantic Bight. A simple advection/diffusion model is used, incorporating particle settling, to interpret obtained data on the particulate aluminum distribution. By matching modeled distributions of particulate aluminum to measurements, an offshore advection velocity and offshore flux are predicted. It is concluded that: (1) advection and settling are the major processes affecting cross-shelf particulate aluminum distributions (i.e. diffusion is insignificant); (2) less than 10% of the sediments delivered to the South Atlantic Bight by rivers is transported across the shelf by this mechanism; and (3) insignificant amounts of inorganic particles of diameters greater than c. 10 microns are removed from the nearshore region. (Author's abstract)
W89-12606

OXYGEN CONCENTRATION PROFILES AND EXCHANGE IN SEDIMENT CORES WITH CIRCULATED OVERLYING WATER.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
For primary bibliographic entry see Field 2K.
W89-12679

AUTOMATED SLURRY SAMPLE INTRODUCTION FOR ANALYSIS OF A RIVER SEDIMENT BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY.
Perkin-Elmer Corp., Norwalk, CT.
For primary bibliographic entry see Field 7B.
W89-12732

MAJOR ION CHEMISTRY OF THE GANGA-BRAHMAPUTRA RIVER SYSTEM: WEATHERING PROCESSES AND FLUXES TO THE BAY OF BENGAL.
Physical Research Lab., Ahmedabad (India).
M. M. Sarin, S. Krishnaswami, K. Dilli, B. L. K. Somayajulu, and W. S. Moore.
Geochemica et Cosmochimica Acta GCACAK, Vol. 53, No. 5, p 997-1009, May 1989. 10 fig, 6 tab, 43 ref. NSF Grant Nos. INT-8117218 and INT-8218484.

Descriptors: *Ganga-Brahmaputra River System, *Sediment discharge, *Ion transport, *Rivers, *Sedimentation, *Weathering, Flux, Clays, Sediment-carrying capacity, Bays, Bicarbonates.

The Ganga-Brahmaputra, one of the world's largest river systems, is first in terms of sediment transport and fourth in terms of water discharge. A detailed and systematic study of the major ion chemistry of these rivers and their tributaries, as well as the clay mineral composition of the bed sediments, has been conducted. The chemistry of the highland rivers (upper reaches of the Ganga, the Yamuna, the Brahmaputra, the Gandak and Ghangra) are all dominated by carbonate weathering (Ca + Mg) and HCO3 account for about 80% of the cations and the anions. In the lowland rivers (the Chambal, the Betwa, and the Ken), HCO3 excess over (Ca + Mg) and a relatively high contribution of (Na + K) to the total cations indicate that silicate weathering and/or contributions from alkaline/saline soils and groundwaters could be important sources of major ions to these waters. The chemistry of the Ganga and the Yamuna in the lower reaches is, by and large, dictated by the chemistry of their tributaries and their mixing proportions. Illite is the dominant clay mineral (about 80%) in the bedload sediments of the highland rivers. Kaolinite and chlorite together constitute the remaining 20% of the clays. In the Chambal, Betwa and Ken, smectite accounts for about 80% of the clays. This difference in the clay mineral composition of the bed sediments is a reflection of the differences in the geology of their drainage basins. The highland rivers weather acidic rocks, whereas the others flow initially through basic effusives. (Author's abstract)
W89-12760

USE OF TERRESTRIAL PHOTOGRAMMETRY AND REFLECTORLESS ELECTRONIC TELEMETRY (EDM) FOR EROSION MEASUREMENTS IN SMALL CATCHMENTS AND COMPARISON WITH MEASUREMENTS OF BED AND SUSPENDED LOADS OF THE BROOK (UTILISATION DE LA PHOTOGRAMMETRIE TERRESTRIE ET LA TELEMETRIE SANS REFLECTEUR POUR LA MESURE DE L'EROSION DE PETITS BASSINS-VERSANTS ET COMPARISON AVEC LES MESURES DE TRANSPORT SOLIDE A L'EMISSAIRE).
Institut Geographique National, Paris (France).
For primary bibliographic entry see Field 7B.
W89-12880

MEASUREMENT AND INTERPRETATION OF THE EROSION PROCESS IN SOUTH ALPS MARLS, ON THE SCALE OF A SMALL GULLY (MEASURE ET INTERPRETATION DU PROCESSUS D'EROSION DANS LES MARINES DES ALPES DU SUD A L'ECHELLE DE LA PETHE RAVINE).
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Saint-Martin d'Heres (France). Grenoble Group.
N. Mathys, M. Meunier, and C. Guet.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 188-192, 1989. 4 fig, 3 ref. English summary.

Descriptors: *Alpine regions, *Gully erosion, *Geomorphology, *Erosion, Marl, Runoff cycle, Rainfall intensity, Regression analysis, Kinetic energy, Catchment basins, Discharge measurement, Error analysis, Seasonal variation, France.

In the experimental catchments of Draix (Alpes-de-Haute-Provence, France), the erosion of black marls of South Alps are studied. Measurements of the smallest basin (1,330 square meters) were made and the quality of the data is examined in order to select those which are usable. After a qualitative analysis of the erosion process, the results of erosion measurements are explained by: detection of thresholds of run-off and erosion; multiple regression with rainfall intensity, kinetic energy of rainfall, discharge, etc., at the scale of an event and at the scale of the season. (Author's abstract)
W89-12881

EROSION OF 'TERRES NOIRES' IN THE BUECH AREA (HAUTES-ALPES, FRANCE): CONTRIBUTION TO THE STUDY OF EROSION PROCESSES IN THE REPRESENTATIVE CATCHMENT BASIN OF SAINT-GENIS (L'EROSION DES TERRES NOIRES DANS LA REGION DU BUECH (HAUTES-ALPES): CONTRIBUTION A L'ETUDE DES PROCESSUS EROSIFS SUR LE BASSIN VERSANT REPRESENTATIF (BVRE) DE SAINT-GENIS).
Aix-Marseille-3 Univ. (France).
M. Bufalo, C. Oliveros, and R. E . Quelennec.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 193-195, 1989. 3 fig, 13 ref. English summary.

Descriptors: *Soil erosion, *Alpine region, *Geomorphology, *Erosion, *Gullies, *France, Sedimentology, Surface runoff, Weathering, Seasonal variation, Rainfall, Soil classification, Geologic units, Soil properties, Climatic data.

In the catchment basin of the Buech (France), the 'Terres Noires' form a highly erodible lithological unit. Within this strongly dissected landscape, a project has been undertaken since 1986 to study the interaction between climate and geology, and weathering and erosion processes. Three elementary gullies (200 to 2,000 square meters) have been equipped for the acquisition of climatological and hydrosedimentological data. The specific erosion is unrelated to the surface area of the gullies. The erosion and weathering processes are strongly seasonal. Rainfalls of less than 10 millimeters are not erosive. An empirical relation between sediment production and certain soil characteristics and rainy periods is presented. (Author's abstract)
W89-12882

SCALE MODEL OF THE 'RIVIERE DES GALETS' (REUNION ISLAND) (MODELE REDUIT PHYSIQUE DE LA RIVIERE DES GALETS (LA REUNION)).
J. Duvoisin.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 201-204, 1989. 3 fig. English summary.

Descriptors: *Hydraulic models, *Bank stabilization, *Erosion control, *Reunion Island, *River mechanics, *Deltas, *Alluvial rivers, Bed load, Embankments, Slope stability, River flow, Particle size, Computer programs, Structural models, Sediment transport.

A scale model of the 'Riviere des Galets' (Reunion Island) was designed in order to better define various solutions to the problem of maintaining stable embankments of the river delta, considering severe natural conditions: 2% slope, 2,400 cubic meters per second centennial flow, large bed load, transport of materials with a wide particle size range (from 50 microns to 1 meter), the effect of materials extraction, etc. The high quality of the means provided by the scale model permits observations and experimental data to be stored on computer diskettes which may be of great use to those interested in the behavior of alluvial torrential rivers with a large bed load. (Author's abstract)
W89-12883

SEDIMENTS IN THE ARVE TORRENTS: FUNCTIONAL DISCONTINUITIES AND IMPACTS OF IMPROVEMENT WORKS ON WATERSHEDS (LES SEDIMENTS DANS LES TORRENTS DE L'ARVE: DISCONTINUITE FONCTIONNELLE ET IMPACTS DE L'AMENAGEMENT DES BASSINS VERSANTS).
Lyon-3 Univ. (France). Dept. of Geography.
J.-L. Peiry.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 205-211, 1989. 5 fig, 1 tab, 9 ref. English summary.

Descriptors: *Sediment transport, *Sediment discharge, *Sediment control, *Watershed management, *Density currents, *Channel morphology, Sediment load, Sediment distribution, Slope protection, Channel improvement, Bed load, Turbidity flow, France, Mountains.

The sediment dynamics of torrents are marked by functional discontinuities: firstly, a long period of sedimentary accumulation in the channel; secondly, a brief period of sedimentary expulsion during density flows, which carry out large volumes of debris and greatly change the channel geomorphology. Since the end of the nineteenth century, man has attempted to control the frequency and the intensity of sedimentary transportation by improvement works on the slopes and in the channel of the river Arve (France); they have favored the retention of the load in the mountain and have diminished the frequency of debris flows. (Author's abstract)
W89-12884

EFFECT OF A SERIES OF POWER STATIONS ON THE SEDIMENT TRANSPORT (BED LOAD AND SUSPENDED LOAD) IN A RIVER: THE CASE OF THE CENTRAL THIRD PART OF THE FRENCH LOWER RHONE (INFLUENCE D'UNE CHAINE D'AMENAGEMENTS HYDROELECTRIQUES SUR LE TRANSPORT SOLIDE EN RIVIERE: APPLICATION AU TIERS CENTRAL DU BAS-RHONE FRANCAIS).
Compagnie Nationale du Rhone, Lyon (France).
E. Tormos, P. Cornier, and M. Scotti.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 215-220, 1989. 4 fig, 5 ref. English summary.

Descriptors: *Dam effects, *Rhone River, *France, *Hydroelectric plants, *Sediment transport, *River basin development, *Water resources development, Sediment distribution, Sediment erosion, Reservoirs, Locks, Tributaries, Bathymetry, Bed load, Sediment load, Dredging.

For the conception and the operation of the multipurpose hydroelectric development of the river Rhone (France), a study was made of the possible effect of these developments on sediment transport by carrying out various experiments. After twenty years of operation of the multi-purpose development of the Rhone area, located between the river Isere junction and the river Ardeche junction, the period seems enough to draw up a balance sheet concerning the evolution of sediment deposits and erosion zones along the reservoirs and the bypassed sections. Such a balance sheet leans on results of periodic bathymetric surveys (facilitated by modern bathymetric methods and data processing) and on the knowledge of the dredged material volumes (river Rhone, tributaries, lock lay-by). (Author's abstract)
W89-12885

CONSEQUENCES OF THE DEGRADATION OF ARVE RIVER ON ITS BANKS AND ON BRIDGES AND OTHER WORKS: COMPREHENSIVE STUDY OF THE SEDIMENT TRANSPORT ALONG ITS COURSE (CONSEQUENCES DE L'ENFONGEMENT DU LIT DE L'ARVE SUR LES BERGES ET LES OUVRAGES: BILAN GENERAL DES TRANSPORTS SOLIDES SUR LE COURS D'EAU).
X. Blanc, F. Pinteur, and T. Sanchis.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 226-230, 1989. 3 fig, 1 tab, 4 ref. English summary.

Descriptors: *Stream degradation, *River beds, *Channel erosion, *Deposition, *Sediment transport, *Bed load, *Bank protection, *Bridges, *Embankments, Economic aspects, Turbidity currents, Trapping, Reservoirs, France.

In the first part of this study, the lowering of the bed of the river Arve (France) is analyzed: its scale, its consequences on banks, bridges, walls, and other works, and the means used to control the process are reviewed. These problems are treated from the point of view of the responsible agency. The technical and financial difficulties usually encountered are described, as well as the remedies available. The second part of the study is presented as a budget of the quantities of materials entering and leaving the system forming the torrent: transported and removed materials, of the bed, trapping of deposits by Verbois reservoir. Unlike the analytical process, this approach frees the authors from studying the complex mechanisms of erosion, transportation, and deposition, and allows them to focus on their results. (Author's abstract)
W89-12886

STUDY OF THE TRANSPORT OF PEBBLES BY TORRENTS BY MEANS OF RADIOACTIVE TRACERS (ETUDE DU TRANSPORT DE GALETS PAR LES TORRENTS AU MOYEN DE TRACEURS RADIOACTIFS).
F. Tola.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 231-234, 1989. 6 fig, 1 tab, 6 ref. English summary.

Descriptors: *Turbulent flow, *Bed load, *Dam construction, *Sediment transport, *Radioactive tracers, Water conservation, Turbidity currents, Radioisotopes, Radioactive half-life, Mathematical models.

Management of rivers and, particularly, the construction of dams require an estimate of the transport of pebbles by rapids located upstream. This transport involves a great number of parameters, most of which cannot be modeled mathematically. Thus, extrapolation of semi-empirical formulas currently available does not allow precise quantification within a reasonable safety margin. The use of pebbles labeled with a radioisotope easily detectable in situ--tantalum 182 (half-life 114 days, energy from 0.07 to 1.2 megavolts)--allows, in most cases, both a qualitative and quantitative study of solids transport by torrents. Numerous experiments, since 1968 have permitted improvement and optimization of the method. (Author's abstract)
W89-12887

CHARACTERISTICS OF DEPOSITS IN COMBINED SEWERS: CONSEQUENCES ON THEIR TRANSPORT (JCARACTERISTIQUES DES DEPOTS EN RESEAU D'ASSAINISSEMENT UNITAIRE: CONSEQUENCES SUR LEUR TRANSPORT).
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
For primary bibliographic entry see Field 5D.
W89-12888

GLACIAL WATERS, CARRIAGE OF SOLID MATERIALS AND DECANTATION IN HYDRO-ELECTRICITY (EAUX GLACIAIRES, TRANSPORTS SOLIDES ET DECANTATION EN HYDRO-ELECTRICITE).
Grande Dixence Societe Anonyme, Sion (Switzerland).
For primary bibliographic entry see Field 8B.
W89-12889

SEDIMENT TRANSPORT MODELLING OF ALLUVIAL RIVERS: AN ACTION OF A NATIONAL NATURE (LA MODELISATION DU TRANSPORT SOLIDE EN RIVIERE: UNE ACTION CARACTERE NATIONAL).
G. Rouas, and P. Monadier.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 259-262, 1989. 1 fig, 10 ref. English summary.

Descriptors: *Alluvial rivers, *Resources development, *Model studies, *Regional planning, *River

beds, *Water resources development, *Sediment transport, Management planning, Optimum development plans, Numerical analysis, Simulation analysis, Mathematical models, Environmental engineering, River mechanics.

Changes in river beds may result from planning and management of rivers. Such changes may have adverse effects. These complex phenomena cannot be simulated from existing knowledge. Engineering approaches may be used for improvement of knowledge and elaboration of numerical models. An approach of a national nature is presented for development of a mathematical model for sediment transport. (Author's abstract)
W89-12890

ALLUVIAL RIVER MODELLING: BED LOAD, GRAIN SORTING AND ARMOURING (MODELES D'EVOLUTION DE LITS ALLUVIONIVAIRES SOUMIS A CHARRIAGE: TRI GRANULOMETRIQUE ET PAVAGE).
Societe Grenobloise d'Etudes et d'Applications Hydrauliques (France).
J.-L. Rahuel, and J.-P. Chollet.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 273-276, 1989. 2 fig, 8 ref. English summary.

Descriptors: *Sediment sorting, *Paving, *Alluvial rivers, *River beds, *Bed load, *Sediment load, *Sediment transport, River flow, Flow characteristics, Flow control, Model studies, Temporal distribution, Spatial distribution, Sediment distribution, Protection, France, Unsteady flow.

A unidimensional model of an alluvial river is developed to take into account temporal and spatial evolution of bed (and bed load) grain compositions. The set of equations is solved in a fully coupled manner; numerical coefficients of the implicit scheme allow optimization of the time step value. A bed load 'loading law' is included in the model. Some examples derived from the general features of the 'middle third' of the Rhone river (France) make clear how the flow unsteadiness affects the bed evolution, through grain sorting and bed armoring. (Author's abstract)
W89-12891

MODELING OF BED LOAD SEDIMENT TRANSPORT FOR FLUVIAL FLOW (MODELISATION DU CHARRIAGE EN ECOULEMENT FLUVIAL).
J. Allard, and P. Chee.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 277-280, 1989. 5 fig, 7 ref. English summary.

Descriptors: *Structural models, *Bed load, *Sediment transport, *Fluvial sediments, *Flumes, Bedload discharge, Natural flow, Hydraulic properties, Particle size, Spatial distribution, Laboratory equipment, Hydraulic friction, Mathematical models.

The mathematical modeling choices of bed load transport in rivers must be confirmed by precise data. Collection of field data is time-consuming and difficult and the parameters of natural flows, such as discharge, cannot be controlled. For these reasons a structural model was set up in the form of a 50-meter-long flume. With the help of precise data, it makes it possible to study independently some of the important physical phenomena involved in bed load transport, such as hydraulic resistance, influence of nonuniformity of grain-size, and spatial lag effects. (Author's abstract)
W89-12892

COMPUTATION OF THE VOLUME OF MUD ERODED IN RESERVOIRS BY FLOODS (SIMULATION NUMERIQUE DE L'EROSION DES VASES DE RETENUE PAR LE CRUES).
J. P. Bouchard, M. Cordelle, and J. Lorin.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 287-291, 1989. 6 fig, 11 ref. English summary.

Descriptors: *Reservoir silting, *Flood flow, *Erosion, *Deposition, *Mud, *Reservoirs, Flumes, Advection, Diffusivity, Suspended sediments, Flumes, Structural models, Simulation analysis.

A study was performed to compute the volume of mud which can be eroded into reservoirs by floods. This study has involved site investigations by means of sample drills and the determination of mud erosion laws through flume tests. The modelization consists of a one-dimensional model for flow and the resolution of an advection-diffusion equation for the suspended matter concentration. The flow of erosion and deposition are computed on a two-dimensional grid of the bottom. (Author's abstract)
W89-12893

OPERATION OF RESERVOIRS AND SEDIMENT TRANSPORTATION (EXPLOITATION DES RETENUES ET TRANSPORT DES SEDIMENTS).
J. M. Cravero, and P. Guichon.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 292-295, 1989. 4 fig. English summary.

Descriptors: *Sediment transport, *Reservoir silting, *Hydroelectric plants, *Reservoir operation, *Alluvial deposits, Water resources management, France, Electric power industry, Drawdown.

A hydropower company, the Generation Division of Electricite de France, presents some results of its follow-up of reservoir silting, including the major problems that are encountered. On-site experiences, such as evacuation of alluvium both during and outside the ten yearly drawdowns for inspection are summarized. (Author's abstract)
W89-12894

SEDIMENT TRANSPORT PREDICTION FROM A WATERSHED: APPLICATION TO RESERVOIR SILTING (PREVISION DU TRANPORTS SOLIDE SUR UN BASSIN VERSANT: APPLICATION A L'ENVASEMENT DUNE RETENUE).
Ecole Nationale des Ingenieurs de Tunis (Tunisia).
S. Rais, and M. Abidi.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 296-300, 1989. 4 fig, 13 ref. English summary.

Descriptors: *Sediment yield, *Sediment load, *Numerical analysis, *Model studies, *Sediment transport, *Watersheds, *Reservoir silting, Computer models, Channels, Topography, Terrain analysis, Particle size, Soil erosion, Soil properties, Hydrologic data, Reservoirs, Tunisia, Prediction, Flood routing.

A numerical model enables the estimation of the quantities of sediments transported from a watershed. The watershed is subdivided into sub-watersheds composed of two sides drained by one single channel. For each sub-watershed the liquid mass is routed first on the two sides then along the channel; afterwards suitable sediment transport formulas are introduced to route the sediments. An control program manages the flow through the whole watershed. The model takes into account its topography, the sediment size of its soils, ground cover density and hydrological data. The model gave good results when compared to actual silting surveys made on a reservoir of the north of Tunisia. (Author's abstract)
W89-12895

TRANPSORT OF SOLIDS OF THE RIVER ARVE INTO THE GENEVA'S RHONE (LES APPORTS SOLIDES DE L'ARVE DANS LE RHONE GENEVOIS).
M. Cohen, and P. Briod.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 301-305, 1989. 4 fig, 2 tab. English summary.

Descriptors: *Sediment transport, *Rhone River, *Reservoir silting, *Dams, *Alluvial deposits, *Flushing, Lake sediments, Alluvial channels, Channel improvement, Maintenance, Water management, France, Reservoir operation.

The dams on the Rhone, downstream of lake Geneva, are in serious danger of clogging owing to alluvial deposits from the river Arve. Flushing practiced regularly has enabled maintenance of the Rhone channel close to its natural state. An operation review over several decades is presented for the dams of Chevres (1896-1942), Verbois (1942-1987), and Chancy-Pougny (1924-1987). (Author's abstract)
W89-12896

UPPER RHONE FLUSHES--REMARKS ON THE ACTIVITIES OF 1987 (LES CHASSES FRANCO-SUISSES SUR LE HAUNT-REFLEXIONS SUR LES OPERATIONS DE 1987).
Compagnie Nationale du Rhone, Lyon (France).
C. Ricard, and L. Levasseur.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 306-310, 1989. 3 fig, 4 ref. English summary.

Descriptors: *Rhone River, *Flushing, *Alluvial deposits, *Reservoir silting, *Sediment transport, Dams, Reservoirs, Water management, Alluvial channels, Suspended load, Turbidity currents, France, Switzerland, Administrative agencies.

Flushings carried out once every three years on the Swiss part of the Rhone river are aimed at the removal of sediment deposits brought by the Arve river into the Verbois reservoir. On the French upper Rhone, the transit of the resulting suspended load is to be secured in the best conditions possible as regards their effect on the natural environment and riparian inhabitants. The Compagnie Nationale du Rhone monitors the sediment flows from the outlets of the Genissiat dam which is the first French scheme downstream from the border. Flushings during June 1987 were carried out in periods of significant flows. They make up an interesting experience for the knowledge of the turbidity current through the Genissiat dam bottom outlet. They also permitted verification of the effectiveness of the operation rules set up in accordance with the instructions of the Rhone-Alpes Authorities Technical water committee. (Author's abstract)
W89-12897

SUSPENDED LOAD OF THE CONGO AND UBANGUI RIVERS.
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France).
J. C. Olivry, J. P. Bricquet, and J. P. Thiebaux.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 311-315, 1989. 4 fig, 14 ref. English summary.

Descriptors: *Suspended load, *Dissolved solids, *Sediment discharge, *Congo River, *Erosion rates, *River basins, Climatic zones, Tropic zone, Ubangi River, Amazon River, Comparison studies, Data collections.

The Congo is the second major world river after the Amazon (mean discharge 41,000 cubic liters per second, area 3,700,000 square kilometers). A large scientific program in the Congo basin followed the variations of the suspended and dissolved matter fluxes and will be used to characterize the mechanical and biogeochemical erosion with hydroclimatological regimes in the equatorial ecosystems. Measurements were made on the Congo at Brazzaville and Ubangi (major northern tributary). The estimate of the suspended load was based on a large representative sampling. The first measurements (1987) gave a sediment discharge to 31,000,000 tons per year for the Congo and 2,900,000 tons per year for the Ubangi (respectively 30 and 43% of matter discharge). The mechanical erosion rates were respectively 8.9 and 6 tons per square kilometer per year. Concentrations were included between 15 and 30 milligrams per liter for the Congo, and 3 and 55 milligrams per liter for the Ubangi. These values are lower than previous published results for the Congo and very small compared with the Amazon (11% for erosion rate and 5% for the sediment discharge). (Author's abstract)
W89-12898

CALCULATION OF RESERVOIR SILTATION.
V. A. Skrylnikov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 8, p 481-486, February 1989. 3 fig, 1 tab, 10 ref.

Descriptors: *Reservoir silting, *Sedimentation rates, Flow characteristics, Settleable solids, Storage capacity, Flow discharge, Sediment transport, Clarification, Sediment discharge.

The rate of siltation of reservoirs is characterized by the degree of clarification of the flow in the lower pool. The most prevalent definition of the change in the settling capacity is the ratio of the storage capacity of the water body to the average water discharge, but it does not take into account the quantity of sediments being transported by the flow and their fractional composition. For characterizing the siltation process we used the ratio of the volume of the channel in which the flow transports the sediments of a given fractional composition and with the water discharge to the reservoir storage capacity. A graph of the settling capacity of reservoirs in relation to the indicated criterion shows that the entire region of change in the degree of clarification can be divided into two zones. The first zone corresponds to the first stage of siltation. The second zone corresponds to increased siltation of the upper pool. It is possible to refer all the possible cases of reservoir siltation to one of three schemes of calculating the deposition of sediments differing in the rate of siltation: (1) the upper pools in which is observed from the start of operation an increasing removal of sediments into the lower pool as siltation of the upper pool increases; (2) reservoirs in which there is a period of complete deposition and a period of increasing removal of sediments into the lower pool; (3) reservoirs with large volumes of water in which the period of complete deposition of sediments covers the main time of siltation. Thus, the proposed method permits determining such reservoirs for which calculations by the existing methods should not be used, and their siltation time is determined by simple division of the storage capacity of the reservoir by the sediment discharge. (Fish-PTT)
W89-12903

FREQUENCY DISTRIBUTION FOR SUSPENDED SEDIMENT LOADS.
Geological Survey, Denver, CO.
R. S. Parker, and B. M. Troutman.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1567-1574, July 1989. 8 fig, 3 tab, 20 ref.

Descriptors: *Suspended load, *Frequency distribution, Suspended sediments, *Sediment load, *Flood discharge, Flood frequency, Streamflow, Mathematical analysis, Flood peak.

A method for deriving a frequency distribution for suspended loads uses a curvilinear regression between the logarithm of annual flood peak and the logarithm of suspended sediments loads associated with that flood peak. It combines this relation with a log-Pearson type III distribution for annual floods to produce a sediment load frequency distribution. Suspended sediments and peak streamflow data collected at a gaging station are used to evaluate the frequency of given sediment dischargers. Sediment load frequency curves were derived for gaging stations in seven different hydrologic regimes (Potomac, Rappahannock, Pearl, Tradewater, Maumee, Paria, and Eel Rivers). Because the annual flood series is generally a much longer record than the suspended sediment record, this method provides a mechanism to reduce the time sampling error (i.e., error due to shortness of record) in sediment load estimates. (Peters-PTT)
W89-12983

BED LOAD TRANSPORT OF MIXED SIZE SEDIMENT: FRACTIONAL TRANSPORT RATES, BED FORMS, AND THE DEVELOPMENT OF A COARSE BED SURFACE LAYER.
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
P. R. Wilcock, and J. B. Southard.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1629-1641, July 1989. 11 fig, 1 tab, 22 ref.

Descriptors: *Model studies, *Sediment transport, *Bed load, *Bench flumes, *Laboratory equipment, Scour, Sediment grading, Shear stress.

Fractional transport rates, bed surface texture, and bed configuration were measured after a mixed size sediment had reached an equilibrium transport state for seven different flow strengths in a recirculating laboratory flume. Fractional transport rates were also measured at the beginning of each run when the bed was well mixed and planar. The start-up observations permitted the description of the variation of fractional transport rates shear stress for a constant bed surface texture and bed configuration. The start-up and equilibrium observation together allow an unambiguous description of the mutual adjustment among the transport, the bed configuration, and the bed surface, as the transport system moves toward equilibrium. A substantial interaction exists among the transport, bed surface, and bed configuration. Bed forms and a coarse surface layer coexist over a range of bed shear stress. Under some flow conditions the size and shape of the bed forms are controlled by the presence of the coarse surface layer. At higher flows the coarse surface layer is eliminated by scour in the lee of the bed forms. If the bed surface is defined as that over which the bed forms move, a coherent relation between the bed surface texture and the transport grain size distribution may be defined. At equilibrium the transport rates of all fractions were not equally mobile, defined as identical transport and bed grain size distributions, although equal mobility was approached for runs in which the bed shear stress was more than twice that for initial motion of the mixture. Under some flow conditions the transport adjusted away from equal mobility as the bed adjusted from a well-mixed start-up condition to an equilibrium state. Development of a partial static armor, wherein some individual grains become essentially immobile even though other grains in the same fraction remain in transport, is suggested to explain these adjustments between the transport and bed surface grain size distributions. The special conditions for which equal mobility must hold and the relevance to natural conditions of flume results and the equal mobility concept are discussed. (Author's abstract)
W89-12989

KARST CONTAGION MODEL: SYNOPSIS AND ENVIRONMENTAL IMPLICATIONS.
Austin Peay State Univ., Clarksville, TN. Dept. of Geology and Geography.
For primary bibliographic entry see Field 2F.
W89-13010

EROSION-BASED LAND CLASSIFICATION SYSTEM FOR MILITARY INSTALLATIONS.
Construction Engineering Research Lab. (Army), Champaign, IL.
S. D. Warren, V. E. Diersing, P. J. Thompson, and W. D. Goran.
Environmental Management EMNGDC, Vol. 13, No. 2, p 251-257, March-April 1989. 2 fig, 30 ref.

Descriptors: *Soil erosion, *Land classification, *Land management, *Satellite technology, *Remote sensing, *Mapping, Universal soil loss equation, Geographic information systems, Geographical resources and support system, Military installations.

The universal soil loss equation (USLE) has been integrated with a geographic information system known as the geographical resources analysis support system (GRASS) to create a land classification system for use by military trainers and land managers to minimize the environmental impacts of military training activities. The USLE provides an estimate of current average annual sheet and rill erosion based upon factors representing climate, soil erodibility, topography, cover, and conservation support practices. The erosion estimate is compared to erosion tolerance values to produce an expression of the current erosion status. An index of inherent site erodibility is also achieved through manipulation of the USLE. Based on published soil surveys, satellite imagery, and ground-truth vegetation transects, data layers are created within GRASS for each of the component factors of the USLE. Appropriate mathematical operations are performed with the data layers, and color-coded maps are produced that represent the erosion status and erodibility index for each 50-m x 50-m area of soil surface. These maps aid military trainers and land managers in scheduling appropriate kinds and intensities of military training activities. (Author's abstract)
W89-13018

MANGANESE INHIBITION OF MICROBIAL IRON REDUCTION IN ANAEROBIC SEDIMENTS.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-13029

OPEN-INCUBATION, DIFFUSION METHODS FOR MEASURING SOLUTE REACTION RATES IN SEDIMENTS.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 2K.
W89-13038

SAND TRANSPORT IN TEXAS TIDAL INLET.
J. D. Bales, and E. R. Holley.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 115, No. 4, p 427-443, July 1989. 6 fig, 1 tab, 16 ref. Texas Parks and Wildlife Department Interagency Agreement Contract (84-85)-1996.

Descriptors: *Sediment transport, *Inlets, *Texas, *Tidal currents, Intracoastal Waterway, Beach erosion, Dredging, Prediction, Performance evaluation, Longshore currents.

Rollover Pass is a manmade, artificially-stabilized tidal inlet on the upper Gulf Coast of Texas. The magnitude of the net annual sand transport through the inlet was estimated: (1) as a percentage of the net longshore transport; (2) from excess beach erosion downdrift of the Pass; and (3) from dredge-material volumes for the Intracoastal Waterway landward of the inlet. Limited direct measurements of sand transport also were made. The excess beach erosion downdrift of the Pass was between 9,000 and 26,000 cu yd/yr, which was in general agreement with the estimation of net annual sand transport calculated as a percentage of longshore transport. Net annual transport through the inlet estimated from extensive data on dredging rates was nearly an order of magnitude greater than estimates based on longshore transport and beach erosion. (Author's abstract)
W89-13120

INFLUENCE OF VESSEL MOVEMENTS ON STABILITY OF RESTRICTED CHANNELS.
Louisiana Ports and Waterways Inst., Baton Rouge, LA.
A. B. Hochstein, and C. E. Adams.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 115, No. 4, p 444-465, July 1989. 14 fig, 4 tab, 18 ref.

Descriptors: *Bank erosion, *Michigan, *Navigable rivers, *Wave wash, Ice cover, Inland waterways, Saint Marys River, Ships, Hydraulic models, Mathematical equations, Seasonal variation, Performance evaluation.

Predictive equations based on a combination of theory and observations have been proposed for quantifying the environmental effects of ship passages through restricted, ice-covered channels. In addition to natural channel flow, the forces considered include ship-induced backwater, propeller jet, and surface-wave-related flows. The equations are used to model forces created by vessels transiting the St. Marys River in northern Michigan during open water conditions and in an extended navigation season when an extensive ice cover is present. Vessel-induced sediment transport is related to water quality problems is examined. Results of model calibration with data collected during summer and winter ship transits of the river suggest a capability for estimating with reasonable accuracy, the environmental effects of navigation in all seasons. The model has been calibrated specifically for the St. Marys River, but it is sufficient-

ly general to be useful in other geographic and environmental settings. (Author's abstract)
W89-13121

SEASONAL VARIATION OF SOIL EROSION BY WATER IN SOUTHWESTERN QUEBEC.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Renewable Resources.
P. C. Kirby, and G. R. Mehuys.
Canadian Journal of Soil Science CJSSAR, Vol. 67, No. 1, p 55-63, February 1987. 5 tab, 26 ref.

Descriptors: *Erosion, *Soil erosion, *Seasonal variation, *Quebec, Runoff, Soil texture, Flowmeters, Rainfall, Snowmelt.

Fallow plots were maintained at four sites that varied with respect to soil type and slope aspect and gradient to determine seasonal patterns of soil loss in southwestern Quebec due to snowmelt and rainfall. Equipment used to measure and record runoff included tipping-bucket flowmeters and Datapod digital recorders. Soil loss was measured on a seasonal basis from September 1983 to August 1985, to compare the percentage of annual soil loss by water that occurred during winter and summer months. Summer soil loss accounted for approximately 80% of the total annual soil loss from coarse-textured sites. Winter soil losses at the fine-textured site were responsible for almost 90% of the annual soil loss from that site. (Author's abstract)
W89-13181

SETTLING AND RHEOLOGY OF MUDS. PART TWO. (TASSEMENT ET RHEOLOGIE DES VASES. DEUXIEME PARTIE).
C. Migniot.
Houille Blanche HOBLAB, No. 2, p 95-111, 1989. 16 fig, 14 tab, 28 ref. English summary.

Descriptors: *Mud, *Sediments, *Silting, *Sedimentation, Mathematical analysis, Salinity, Estuaries, Erosion, Rheology, Interstitial water, Gironde River, France, Organic matter, Temperature, Turbidity.

Information on the settling conditions of very thin sediment deposits, of the muds, silts, or alluvium type--and their consistency modifications day after day are a principal element in evaluating silting problems in a site and in finding the best solution. Various research projects carried out during the last 20 yrs by the French Laboratoire Central d'Hydraulic, relating to mud settling and rheology are reviewed. The influence of such parameters as the nature and size of the particles, the percentage of sand, the salinity of the interstitial water, the presence of organic material, and temperature, were evaluated. Erosion and mud transport in estuaries was also investigated. Results obtained on sediments of very different mineralogical, chemical and granulometric types, associated with waters more or less rich in salts, have led to the development of a number of empirical laws, expressed in a series of equations, on the evolution of the density and rigidity of the mud deposits. (Peters-PTT)
W89-13188

DOWNSTREAM IMPACTS OF A DAM ON A BEDROCK FLUVIAL SYSTEM, BRAZOS RIVER, CENTRAL TEXAS.
Baylor Univ., Waco, TX. Dept. of Geology.
For primary bibliographic entry see Field 6G.
W89-13194

DEBRIS FLOWS AND HYPERCONCENTRATED FLOODS ALONG THE WASATCH FRONT, UTAH, 1983 AND 1984.
Geological Survey, Reston, VA.
G. F. Wieczorek, E. W. Lips, and S. D. Ellen.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 26, No. 2, p 191-208, 1989. 8 fig, 6 tab, 70 ref.

Descriptors: *Mass wasting, *Landslides, *Sediment transport, *Floods, *Saturated flow, *Hyperconcentrated floods, *Wasatch Front, *Utah, *Landslides, Excess water, Soil water, Snowmelt, Channel morphology, Thunderstorms, Snowpack, Rainfall intensity, Canyons, Channel scour.

The Wasatch Front north of Salt Lake City has a recurrent history of debris flows. Two different types of climatic events-summer thunderstorms and rapid spring snowmelts-have triggered debris flows. Heavy autumn rains, exceptional winter snowpacks, and cool and extended springs followed by sudden warming characterized weather during 1983 and 1984. As a result of these events, large amounts of water were rapidly added to the landscape, resulting in several hundred landslides, many of which mobilized into debris flows and (or) hyperconcentrated floods. Reconnaissance during June of 1983 revealed many hillsides with recently active landslides that had moved slightly but had not mobilized. A technique was developed for evaluating the potential for debris flows and hyperconcentrated floods to reach canyon mouths, based on three assumptions: (1) debris flows would occur in response to a large influx of water to the soils, either from a thunderstorm or rapid snowmelt; (2) the partly-detached landslides were the mot likely sources for future debris flows; and (3) debris-flow material incorporated from channels would be proportional to that from landslide sources. Slightly fewer debris flows occurred in 1984 than in 1983, consistent with a slightly lower snowpack water content and slightly slower rate of melting. Debris flows occurred near the rapidly receding snowline, apparently as a result of the large influx of water into the soils there. On an areal basis, partly-detached landslides identified in 1983 were statistically significant as sources for debris flows in 1984. In the few documented cases, the contribution of material scoured from channels was variable but very high and appeared significantly influenced by the geomorphic condition of the stream channel. (Author's abstract)
W89-13195

LAKE, MIRE AND RIVER ENVIRONMENTS, DURING THE LAST 15,000 YEARS.
For primary bibliographic entry see Field 2H.
W89-13295

PECULARITIES OF SEDIMENTATION IN THE SMALL ESTONIAN LAKES.
Akademiya Nauk Estonskoi SSR, Tallinn. Inst. Geologii.
L. Saarse.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 67-76, 9 fig, 3 tab, 10 ref.

Descriptors: *Limnology, *Paleolimnology, *Geomorphology, *Palynology, *Sedimentation, *Lake sediments, Tectonics, Climatology, Lithology, History, Geology.

The sedimentation in the Estonian lakes depends on tectonic pattern, climatic conditions, lithology of sediments in the drainage area, geological-geomorphological features of the lake basin and hydrochemical conditions. According to palynological data, the accumulation of lake deposits started in South Estonia during Older Dryas, in North Estonia at the end of the Allerod. Late-glacial minerogenic deposits consist of hydromicas and quartz with kaolinite, chlorites, mixed-layer clay minerals, feldspar, calcite and dolomite, aragonite, pyrite, siderite, gypsum, feldspar and clay minerals. The results obtained from investigations on Holocene lake deposits prove that the following early diagenetic changes in gyttja took place: increase in the ratio C/N; decrease in the total amount of easily hydrolysed compounds; and increasing quantity of alkali-soluble (humic) compounds. Taking into account the distribution and frequency of macrophyte pollen, fragments of terraces, changes of the bed limits and peculiarities of mollusc fauna the main tendency of water level changes were determined. (See also W89-13295) (Lantz-PTT)
W89-13301

SEDIMENTATION AND LOCAL VEGETATION DEVELOPMENT OF A REFERENCE SITE IN SOUTHWESTERN BULGARIA.
Sofia Univ. (Bulgaria). Faculty of Biology.
S. Tonkov.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 99-101, 1 fig, 5 ref.

Descriptors: *Palynology, *Limnology, *Paleolimnology, *Fens, *Bulgaria, *Sedimentation, Vegetation, History, Stratigraphy, Radioactive dating.

Pollen-analytical and stratigraphical investigations were carried out in Southwestern Bulgaria on two cores from the largest minerotrophic topogenous fen, to study its formation and vegetation history. Five stages in the development of the basin and the local vegetation during the last 8000 years were delineated on the basis of a detailed description of the sediments accumulated and the changes in the pollen record that were supported by 9 radiocarbon datings. These stages are: Period I--radiocarbon age interval from 8000-4760 bp; Period II--radiocarbon years 4760-2100 bp; Period III--2100-1860 bp; Period IV--radiocarbon years 1860-1250 bp; and Period V--from the development of the marsh after 1250 bp. (See also W89-13295) (Lantz-PTT)
W89-13304

OUTLINE OF RIVER ADJUSTMENTS IN SMALL RIVER BASINS IN BELGIUM AND THE NETHERLANDS SINCE THE UPPER PLENIGLACIAL.
Rijks Geologische Dienst, Haarlem (Netherlands).
For primary bibliographic entry see Field 2E.
W89-13307

EVOLUTION OF THE MORAVA RIVER IN LAKE PLEISTOCENE AND HOLOCENE TIME.
Ustredni Ustav Geologicky, Prague (Czechoslovakia).
For primary bibliographic entry see Field 2E.
W89-13308

NEW METHODS OF RESEARCH ON THE HOLOCENE PALEOHYDROGRAPHY OF HUNGARY.
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 2H.
W89-13309

HISTORY OF THE HYDROGRAPHY OF HUNGARY AND THE CARPATHIAN BASIN DETERMINED BY LARGE-SCALE TECTONICS.
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
O. Radai.
IN: Lake, Mire and River Environments, During the Last 15,000 Years. Proceedings of the INQUA/IGCP 158 Meeting on the Palaeohydrological Changes During the Last 15,000 Years, Bern, Switzerland, June 1985. A. A. Balkema, Rotterdam, The Netherlands. 1988. p 145-151, 12 fig, 8 ref.

Descriptors: *Geologica history, *Geomorphology, *Paleohydrology, *Geology, *Hungary, *Tectonics, Erosion, Geohydrology, Remote sensing, Maps, History.

The natural hydrography of the Carpathian Basin and of Hungary is strongly influenced, or in most cases totally controlled, by the large scale tectonic activity of the area. The tectonic pattern of this part of Europe is mainly the result of a geotumor (subcrustal erosion caused by the latent-flowing material of the upper mantle of the earth). Other factors, like relatively small-scale convection cells (geo-blisters) of the mantle material, impact of asteroids and meteorites, dissolution of rocks, dep-

osition, action of organic bodies (corals) and tectonics, might be responsible for the 'ornamenting' forms which give the characteristic pattern of the hydrography of the area. All of these forms, being very consistent and logical, were revealed by the interpretation of thousands of air photos and several satellite images; the investigations have been supplemented by the maps with reconstructions of the original, natural hydrography of the area. (See also W89-13295) (Lantz-PTT)
W89-13310

HOLOCENE VALLEY DEVELOPMENT ON THE UPPER RHINE AND MAIN.
Duesseldorf Univ. (Germany, F.R.). Abt. Geologie.
For primary bibliographic entry see Field 2E.
W89-13311

TECTONIC, ANTHROPOGENIC AND CLIMATIC FACTORS IN THE HISTORY OF THE VISTULA RIVER VALLEY DOWNSTREAM OF CRACOW.
Polish Academy of Sciences, Krakow. Inst. of Geography and Spatial Organization.
For primary bibliographic entry see Field 2E.
W89-13312

PLEISTOCENE-HOLOCENE BOUNDARY IN THE PO VALLEY SOUTH OF TORINO (NW ITALY).
Consiglio Nazionale delle Ricerche, Turin (Italy). Ist. di Ricerca per la Protezione Idrogeologica nel Bacino Padano.
For primary bibliographic entry see Field 2E.
W89-13313

VALLEY FLOOR DEVELOPMENT AND PALEOHYDROLOGICAL CHANGES: THE LATE VISTULIAN AND HOLOCENE HISTORY OF THE WARTA RIVER (POLAND).
Adam Mickiewicz Univ., Poznan (Poland). Quaternary Research Inst.
For primary bibliographic entry see Field 2E.
W89-13314

PROBLEM OF THE HYDROLOGICAL INTERPRETATION OF PALAEOCHANNEL PATTERN.
Adam Mickiewicz Univ., Poznan (Poland). Inst. of Physical Geography.
For primary bibliographic entry see Field 2E.
W89-13315

STUDY OF RAINFALL SIMULATORS, RUNOFF AND EROSION PROCESSES, AND NUTRIENTS YIELDS ON SELECTED SITES IN ARIZONA AND NEW MEXICO.
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W89-13321

EVALUATION OF A WATERSHED MODEL TO SIMULATE SEDIMENT TRANSPORT IN A SMALL AGRICULTURAL WATERSHED IN INDIANA.
Geological Survey, Indianapolis, IN. Water Resources Div.
L. D. Arihood.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $6.75, microfiche $4.00. USGS Water-Resources Investigations Report 88-4222, 1989. 40p, 3 fig, 11 tab, 6 ref.

Descriptors: *Model testing, *Model studies, *Indiana, *Model studies, *Sediment transport, *Sediment yield, Sediment concentration, Sediment discharge.

The streamflow and sediment components of the watershed model, 'Hydrologic Simulation Program-Fortran', were evaluated using 2 years and 9 months of data from a 2.7-sq mi agricultural watershed in Indiana. Hydrographs of simulated sediment concentration generally have smaller peaks and longer recessions than do hydrographs of measured data. The attenuation of simulated peaks was partly caused by difficulties in designing a representative channel system. Simulated surface runoff during low-intensity rainfall was greater than measured surface runoff; this caused an overestimation of sediment concentration and discharge. Rainfalls of low intensity were mostly absorbed by the soil, but the model predicted that the amount of surface runoff from such storms would be large. The overly large volume of simulated surface runoff transported more sediment than actually occurred. The mean absolute error of mean sediment concentrations during storms is 45% of the measured average concentration. The error resulted from a combination of error in recording streamflow and rainfall, in simulating streamflows, and in simulating sedimentation processes. The largest percent errors are associated with simulated maximum streamflows and average sediment discharges. The root-mean-square errors are 93 and 102% of the measured maximum streamflow and average sediment discharges. (USGS)
W89-13334

USE OF SURFACE-GEOPHYSICAL METHODS TO ASSESS RIVERBED SCOUR AT BRIDGE PIERS.
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-13344

HYDRAULIC GEOMETRY AND SEDIMENT DATA FOR THE SOUTH FORK SALMON RIVER, IDAHO, 1985-86.
Geological Survey, Boise, ID. Water Resources Div.
R. P. Williams, I. O'Dell, and W. F. Megahan.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-233, 1989. 22p, 1 fig, 12 tab, 4 ref.

Descriptors: *Bed load, *Chemical properties, *Data collections, *Idaho, *Suspended sediments, *Salmon River, *Sediment discharge, Hydraulic geometry.

Hydraulic geometry data for the South Fork Salmon River, Buckhorn Creek, and North Fork Lick Creek, Idaho, are presented in tables. Water surface slopes were obtained by surveying elevations at the respective sites and at reference points upstream and downstream from the initial point. Suspended-sediment data are listed in tables. Water samples for analyses of suspended sediment were collected using US DH-48 and US DH-59 suspended-sediment samplers and the equal-width increment method. In addition to total sediment concentration, a sand-silt spilt was determined by wet-sieve analysis using a 0.062-millimeter sieve. Suspended-sediment discharge was computed as discharge (tons per day)=water discharge (cubic feet per second) x suspended-sediment = water discharge (cubic feet per second) x suspended-sediment concentration (milligrams per liter) x the constant 0.0027. Bedload samples were collected using a Helley-Smith bedload sampler with a 3 sq inch orifice. Field tests of the sampler indicated near-perfect efficiency. Samples were collected at 12-26 equally spaced cross-section locations. The sampling duration ranged from 30 sec to 120 sec but consistent time was used for each transect. The samples were air dried and size distribution was determined by dry-sieve analysis using Tyler and U.S. standard sieves with mesh-size openings that decrease by a factor of 1.414. Each sample (in the set of sieves) was shaken for 15-20 minutes on a Ro-tap shaker. Bedload particle-size distributions for the sites are presented in tables. (USGS)
W89-13361

HYDRAULIC DATA FOR SHALLOW OPEN-CHANNEL FLOW IN A HIGH-GRADIENT FLUME WITH LARGE BED MATERIAL.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W89-13387

LATE QUATERNARY PALEOHYDROLOGY OF THE EASTERN MOJAVE RIVER DRAINAGE, SOUTHERN CALIFORNIA: QUANTITATIVE ASSESSMENT OF THE LATE QUATERNARY HYDROLOGIC CYCLE IN LARGE ARID WATERSHEDS.
New Mexico Univ., Albuquerque. Dept. of Geology.
For primary bibliographic entry see Field 2A.
W89-13404

2K. Chemical Processes

CHEMISTRY OF RAINWATER AND CLOUD WATER AT REMOTE SITES IN ALASKA AND OREGON.
Pacific Northwest Forest and Range Experiment Station, Juneau, AK. Forestry Sciences Lab.
For primary bibliographic entry see Field 5B.
W89-12175

TEMPORAL VARIATION IN NITRATE AND NUTRIENT CATIONS IN DRAINAGE WATERS FROM A DECIDUOUS FOREST.
Great Lakes Forestry Research Centre, Sault Sainte Marie (Ontario).
For primary bibliographic entry see Field 5C.
W89-12187

SORPTION KINETICS OF LOW-MOLECULAR-WEIGHT HYDROPHOBIC ORGANIC COMPOUNDS ON SURFACE-MODIFIED SILICA.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5B.
W89-12193

CHEMICAL COMPOSITION OF WATER AND PLANKTON IN A COOLANT-RESERVOIR (ATOMIC-ENERGY) IN SOUTHERN UKRAINE (KHIMICHESKII SOSTAV VODY I PLANKTON VODOEMA-OKHLADITELIA IUZHNO-UKRAINSKII AES).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5B.
W89-12271

EXTRACELLULAR ENZYMATIC ACTIVITY OF AQUATIC AND AERO-AQUATIC CONIDIAL FUNGI.
Basrah Univ. (Iraq). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-12305

CHANGES IN THE CHEMISTRY OF SURFACE WATERS: 25-YEAR RESULTS OF THE HUBBARD BROOK EXPERIMENTAL FOREST, NH.
Syracuse Univ., NY.
C. T. Driscoll, G. E. Likens, L. O. Hedin, J. S. Eaton, and F. H. Bormann.
Environmental Science and Technology ESTHAG, Vol. 23, No. 2, p 137-143, February 1989. 2 fig, 48 ref.

Descriptors: *Field tests, *New Hampshire, *Acid rain, *Hubbard Brook, *Streams, *Sulfates, Rainfall, Cations, Acidity, Chemical properties, Precipitation, Regulations, Legal aspects.

An important focus of the current U.S. assessment of the effects of acidic deposition on surface waters is the reconstruction of historic patterns and the prediction of future trends in surface water quality. A 25-year continuous record of the chemistry of bulk precipitation and headwater streams is available at the Hubbard Brook Experimental Forest (HBEF) in New Hampshire. This report discusses how long-term changes in elemental deposition from the atmosphere have apparently altered the chemical characteristics of headwater streams at

the HBEF. Because of the marked decline in their atmospheric deposition, total ecosystem inputs of basic cations to the HBEF are currently near the lowest value for the last 25 years, and this decline has greatly increased ecosystem sensitivity to strong acid loading. It would appear that expected recovery of acidified surface waters due to decreased loading of sulfate generally has been retarded by declining atmospheric inputs of basic substances. It is concluded that future efforts to improve water quality through air emission legislation should address the increasing acid sensitivity of these systems caused by declining base inputs as well as inputs of strong acids. (Doria-PTT)
W89-12385

ISOTOPIC AND TRACE ELEMENT CONSTRAINTS ON THE ORIGIN AND EVOLUTION OF SALINE GROUNDWATERS FROM CENTRAL MISSOURI.
California Inst. of Tech., Pasadena. Div. of Geological and Planetary Sciences.
J. L. Banner, G. J. Wasserburg, P. F. Dobson, A. B. Carpenter, and C. H. Moore.
Geochimica et Cosmochimica Acta GCACAK, Vol. 53, No. 2, p 383-398, February 1989. 11 fig, 4 tab, 84 ref. NSF EAR Grants 86-18526, 85-04096; DOE Grant DE-FG03-88ER13851.

Descriptors: *Isotope studies, *Trace elements, *Saline water, *Geochemistry, *Water chemistry, *Groundwater, *Missouri, Sodium, Calcium, Chlorides, Salinity, Meteoric water, Recharge, Oxygen isotopes, Geohydrology, Mixing, Model studies.

Na-Ca-Cl groundwaters with salinities of 1 to 30% discharge from natural springs and artesian wells in Mississippian carbonates and Ordovician sandstones and carbonates in central Missouri. Carbonate saturation and quartz supersaturation are maintained throughout the salinity range. Major and trace element and isotopic variations in the waters are used to place constraints on models for rock-water interaction and regional hydrology. The waters apparently acquired their delta O18 and delta D values as meteoric recharge and their Sr87/Sr86 and rare earth element signatures from extraformational crustal sources and largely preserved these isotopic signatures during subsequent migration through the carbonates. Chemical exchange via rock-water interaction is required for isotopic exchange to occur. Therefore, the present state of chemical equilibrium between the groundwaters and carbonate aquifer minerals may serve to limit rock-water interaction, and hence preserve the extraformational isotopic signatures in the waters. The integration of geochemical, isotopic and hydrologic data on a local and regional scale suggests a history for the central Missouri groundwaters involving: (1) meteoric recharge in the Front Range of Colorado; (2) dissolution of Permian halite in the subsurface of Kansas; (3) interaction with predominantly silicate mineral assemblages in Paleozoic strata (and possibly Precambrian basement), with acquisition of crustal Sr and REE signatures; (4) dilution and migration to shallow aquifer levels in central Missouri; and (5) mixing with local meteoric recharge and discharge through Mississippian carbonates with no significant change of the isotopic signatures acquired in stage (3). (Author's abstract)
W89-12399

PHYSICO-CHEMICAL CHARACTERISTICS OF A COLLOIDAL IRON PHOSPHATE SPECIES FORMED AT THE OXIC-ANOXIC INTERFACE OF A EUTROPHIC LAKE.
Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
J. Buffle, R. R. De Vitre, D. Perret, and G. G. Leppard.
Geochimica et Cosmochimica Acta GCACAK, Vol. 53, No. 2, p 399-408, February 1989. 14 fig, 2 tab, 44 ref.

Descriptors: *Eutrophic lakes, *Colloids, *Iron, *Phosphates, *Interfaces, Boundary layers, Electron microscopy, Particle size, Phosphorus, Calcium, Aluminum, Silicon, Chemical properties.

Natural iron oxyhydroxide colloidal particles have been isolated from the redox transition boundary layer in a eutrophic lake. They have been physically and chemically characterized on a particle-specific basis using new technology from the biomedical sciences which enables minimization of artifacts of particle sizing and optimization of the microscopical parameters for chemically quantifying their elemental composition by scanning transmission electron microscopy/energy dispersive spectrometry. The Fe-rich particles have also been macroscopically analyzed using classical techniques. The Fe particle size range lies between 0.4 and 0.04 microns, the latter limit being determined by experimental conditions. Particles larger than 0.4 microns have also been observed but are loose aggregates of smaller Fe-rich particles. Chemically, the predominant particle type contains Fe, P, and Ca exclusively, although occasional associations of the latter elements with Si or Si/Al occur. The former three elements are strongly correlated, and the mean molar ratios in the particles are 0.25, 0.19, and 1.34 for P/Fe, Ca/Fe, and P/Ca, respectively. The Fe is approximately 50% Fe(II) and the P is present as phosphate. Although a good correlation exists between Al and Si, neither is significantly correlated to Fe, P, or Ca. The chemical composition is relatively constant spatially seasonally and yearly. These results indicate that a well-defined chemical entity is formed at the redox interface in the water column, composed mostly of Fe(III), Fe(II), PO4, and Ca (and probably OH(-)). (Author's abstract)
W89-12400

METHANE PRODUCTION, SULFATE REDUCTION AND COMPETITION FOR SUBSTRATES IN THE SEDIMENTS OF LAKE WASHINGTON.
Washington Univ., Seattle. School of Oceanography.
K. M. Kuivila, J. W. Murray, A. H. Devol, and P. C. Novelli.
Geochimica et Cosmochimica Acta GCACAK, Vol. 53, No. 2, p 409-416, February 1989. 3 fig, 3 tab, 44 ref. NSF Grants OCE-8416258, OCE-8601397.

Descriptors: *Methane, *Sulfates, *Lake Washington, *Sediments, *Chemical reduction, *Lake sediments, Carbon dioxide, Fermentation, Anaerobic conditions, Respiration, Chemical reactions, Bacteria, Methane bacteria, Sulfur bacteria, Hydrogen, Lakes.

Rates of methane production (both acetate fermentation and CO2 reduction) and sulfate reduction were directly measured as a function of depth in the sediments of Lake Washington. Although methanogenesis was the primary mode of anaerobic respiration (63%), the major zone of methane production existed only below the sulfate reduction zone (16 cm). Acetate fermentation accounted for 61 to 85% of the total methane production, which is consistent with other low sulfate environments. The observed spatial separation of methane production and sulfate reduction is attributed to competition between the methane-producing and sulfate-reducing bacteria for acetate and hydrogen. This hypothesis is supported by the strong correlation between the measured distributions of acetate and hydrogen and the rates of methane produced from these two precursors in Lake Washington sediments. Acetate concentrations increased rapidly once the sulfate concentration decreased below 30 microM and methane production via acetate fermentation began. A similar trend was observed for hydrogen concentrations, which increased from 7 to 22 nM up to 40 to 55 nM, at the onset of methanogenesis from CO2 and H2 (sulfate concentrations of 35-40 microM). These results show, for the first time in a freshwater lake, the separation of methane production and sulfate reduction and the corresponding changes in acetate and hydrogen concentrations. (Author's abstract)
W89-12401

MODEL FOR INORGANIC CONTROL OF PHOSPHATE CONCENTRATIONS IN RIVER WATERS.
Harvard Univ., Cambridge, MA. Dept. of Earth and Planetary Sciences.
L. E. Fox.
Geochimica et Cosmochimica Acta GCACAK, Vol. 53, No. 2, p 417-428, February 1989. 10 fig, 3 tab, 82 ref.

Descriptors: *Phosphates, *Rivers, *Thermodynamics, *Iron, Equilibrium, Model studies, Orthophosphates, Model testing, Solubility, Saturation, Colloids, Chemical properties, Hydrogen ion concentration.

A thermodynamic model is based on the supposition that phosphate concentrations in major rivers are controlled through equilibration with a solid-solution of amorphous ferric phosphate in amorphous ferric hydroxide. A series of laboratory-based dialysis experiments were performed involving the manipulation of orthophosphate, hydrogen ion, and amorphous solid Fe/P ratios in samples consisting of model solutions and river water samples. Data from three different model solution preparations and six different rivers, once equilibrated, provide a good fit to model equations, satisfy the molar Fe/P and P/H ratio requirements, and provide an independent estimate of the solubility product of colloidal ferric phosphate which equals the mean solubility product previously reported. In addition, all dissolved ferric iron is near saturation with respect to colloidal ferric hydroxide. In order to test the applicability of this model to natural waters, measurements were made from dissolved and solid phase constituents taken from solutions of colloidal ferric hydroxide and phosphate prepared at varying solid Fe/P ratios and from waters of the Amazon, Negro, Delaware, Mullica, Hudson, and Sepik rivers with and without additions of phosphate and manipulation of pH. Results provide a good fit to the above equations, suggesting that solid-solution formation on amorphous surfaces of ferric hydroxide suspensions, specifically amorphous ferric phosphate dissolved in ferric hydroxide, could be a major process governing concentrations of dissolved phosphate in many of the world's rivers. (Doria-PTT)
W89-12402

ROLE OF SEASONAL SALT AND WATER FLUXES IN THE GENESIS OF SOLONETZIC B HORIZONS.
Environment Canada, Lethbridge (Alberta). Earth Sciences Div.
For primary bibliographic entry see Field 2G.
W89-12430

BORON AND SALINITY SURVEY OF IRRIGATION PROJECTS AND THE BORON ADSORPTION CHARACTERISTICS OF SOME SASKATCHEWAN SOILS.
National Hydrology Research Inst., Saskatoon (Saskatchewan).
W. Nicholaichuk, A. J. Leyshon, Y. W. Jame, and C. A. Campbell.
Canadian Journal of Soil Science CJSSAR, Vol. 68, No. 1, p 77-90, February 1988. 1 fig, 10 tab, 24 ref.

Descriptors: *Boron, *Salinity, *Irrigation practices, *Saskatchewan, *Soil properties, Alfalfa, Water quality, Adsorption, Plant growth, Toxicity, Soil types, Surveys, Soil texture.

The soil and irrigation water quality and the boron content of alfalfa (Medicago sativa) were assessed at 29 irrigation projects in Saskatchewan. Langmuir and Freundlich boron adsorption equations were determined for another 13 soils that allowed assessment of the effect of soil zone and texture on these relationships. It was found that, except for a few locations where crops sensitive to boron may experience some problems, water quality with respect to boron was acceptable for most projects. The survey showed that salinity posed more of a threat to production under irrigation than did boron toxicity. Boron toxicity was closely associated with salinity problems. Freundlich equations described the data for the 13 soils best; K values ranged between 0.24 and 2.04. These values were not affected by soil zone; coarse-textured soils had K values less than 0.5 and fine-textured soils values

greater than 1.5. The data can be used to determine where the irrigation practice of individual irrigation projects in Saskatchewan is appropriate for maintaining proper salt balance in the soils so as not to impede plant growth. (Author's abstract)
W89-12434

SOIL CHEMICAL CRITERIA FOR IRRIGATION SUITABILITY CLASSIFICATION OF BROWN SOLONETZIC SOILS.
Agriculture Canada, Lethbridge (Alberta). Land Evaluation and Reclamation Branch.
For primary bibliographic entry see Field 2G.
W89-12450

CLASSIFICATION OF CULTIVATED ESTUARINE ACID SULFATE SOILS IN QUEBEC.
Agriculture Canada, Ottawa (Ontario). Land Resource Research Centre.
For primary bibliographic entry see Field 2G.
W89-12453

INFLUENCE OF WATER TABLE LEVELS ON METHANE AND CARBON DIOXIDE EMISSIONS FROM PEATLAND SOILS.
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 2G.
W89-12455

COLLOIDS IN WATER FROM A SUBSURFACE FRACTURE IN GRANITE ROCK, GRIMSEL TEST SITE, SWITZERLAND.
Paul Scherrer Inst., Wuerenlingen (Switzerland).
For primary bibliographic entry see Field 5B.
W89-12474

GEOCHEMICAL PROCESSES IN THE LAKE FRYXELL BASIN (VICTORIA LAND, ANTARCTICA).
Miami Univ., Oxford, OH. School of Interdisciplinary Studies.
For primary bibliographic entry see Field 2H.
W89-12558

SOME ASPECTS OF IRON CYCLING IN ANTARCTIC LAKES.
British Antarctic Survey, Cambridge (England).
For primary bibliographic entry see Field 2H.
W89-12559

CHEMICAL CHARACTERISTICS OF POND WATERS IN THE LABYRINTH OF SOUTHERN VICTORIA LAND, ANTARCTICA.
Chiba Inst. of Tech., Narashino (Japan).
For primary bibliographic entry see Field 2H.
W89-12567

PHOSPHORUS IN SOIL, WATER, AND SEDIMENT: AN OVERVIEW.
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5B.
W89-12575

BACKGROUND YIELD OF PHOSPHORUS FROM DRAINAGE AREA AND ATMOSPHERE: AN EMPIRICAL APPROACH.
National Swedish Environmental Protection Board, Uppsala (Sweden). Environmental Quality Lab.
For primary bibliographic entry see Field 5B.
W89-12576

PARTICULATE AND DISSOLVED PHOSPHORUS FORMS IN FRESHWATER: COMPOSITION AND ANALYSIS.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5B.
W89-12578

PHOSPHORUS IN SEDIMENTS: SPECIATION AND ANALYSIS.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5B.
W89-12579

BIOAVAILABILITY OF DIFFERENT PHOSPHORUS FORMS IN FRESHWATER SYSTEMS.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5B.
W89-12581

PHOSPHORUS AS A GROWTH-REGULATING FACTOR RELATIVE TO OTHER ENVIRONMENTAL FACTORS IN CULTURED ALGAE.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W89-12584

PHYTOPLANKTON BIOMASS AND PRODUCTION IN RELATION TO PHOSPHORUS.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5C.
W89-12585

EXCHANGE OF PHOSPHORUS ACROSS THE SEDIMENT-WATER INTERFACE.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W89-12586

INFLUENCE OF AQUATIC MACROPHYTES ON PHOSPHORUS CYCLING IN LAKES.
Lund Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 5B.
W89-12587

INFLUENCE OF ANIMALS ON PHOSPHORUS CYCLING IN LAKE ECOSYSTEMS.
Lund Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 5B.
W89-12588

EMPIRICAL AND THEORETICAL MODELS OF PHOSPHORUS LOADING, RETENTION AND CONCENTRATION VS. LAKE TROPHIC STATE.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W89-12589

DETERMINATION OF TOTAL ORGANIC CARBON IN WATER IN THE FORM OF CARBAMATE BY MEANS OF A SIMPLE DENUDER/ELECTROLYTIC CONDUCTIVITY FLOW CELL SYSTEM.
Kozponti Kemiai Kutato Intezete, Budapest (Hungary).
For primary bibliographic entry see Field 7B.
W89-12600

OXYGEN CONCENTRATION PROFILES AND EXCHANGE IN SEDIMENT CORES WITH CIRCULATED OVERLYING WATER.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
J. P. R. A. Sweerts, V. St Louis, and T. E. Cappenberg.
Freshwater Biology FWBLAB, Vol. 21, No. 3, p 401-409, June 1989. 4 fig, 3 tab, 32 ref.

Descriptors: *Geochemistry, *Diagenesis, *Bottom sediments, *Sediment-water interfaces, *Sedimentology, *Dissolved oxygen, *Oxygen transfer, Cores, Water circulation, Mixing, Oxygen profiles, Laboratory studies, Diffusion, Oxygen penetration, Boundary layers, Turbulent flow.

The overlying water of intact sediment cores was constantly stirred with an impeller at a rate sufficient to turbulently mix the water column and maintain the diffusive boundary layer at a determined thickness in order to provide standardized water circulation for laboratory sediment core experiments. When the overlying water was not stirred for 24 hr (as measured with oxygen microelectrodes in a sediment core), the oxygen concentration decreased by 70% and the oxygen penetration depth in the sediments decreased from 4.2 mm to 2.0 mm. If the overlying water was stirred, the in situ saturated oxygen concentration remained constant and after about 24 hr oxygen profiles were similar to those at the start of the experiment. Oxygen profiles measured in sediment cores in the laboratory were similar to those measured in situ when the overlying water was stirred with an impeller at such a rate that a similar thickness of the diffusive boundary layer at the sediment-water interface developed in the laboratory as that in situ. Sediment oxygen consumption was then calculated from: (1) measured oxygen profiles in the diffusive boundary layer and the molecular diffusion coefficient for oxygen in water; (2) the measured oxygen decrease in the top of the sediments and the estimated diffusion coefficient in the sediment; and (3) by oxygen differences in the overlying water after incubation of sediment cores. The sediment oxygen consumption rates as estimated by these three different methods were quite similar in the sediments investigated, using sediment cores with stirred overlying water with an impeller and a defined thickness of the diffusive boundary layer. (Author's abstract)
W89-12679

COPPER COMPLEXATION IN EUTROPHIC AND HUMIC LAKE TJEUKEMEER, THE NETHERLANDS.
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 2H.
W89-12680

EFFECTS OF NATURAL ORGANIC MATTER AND CALCIUM ON OZONE-INDUCED PARTICLE DESTABILIZATION.
Camp, Dresser and McKee, Inc., Raleigh, NC.
W. B. Dowbiggin, and P. C. Singer.
Journal of the American Water Works Association JAWWA5, Vol. 81, No. 6, p 77-85, June 1989. 14 fig, 1 tab, 36 ref.

Descriptors: *Water treatment, *Coagulation, *Calcium, *Particle destabilization, *Organic matter, *Ozone, Decomposing organic matter, Alumina, Colloids, Suspension.

The susceptibility of alumina particles to ozone-induced destabilization in the presence of humic material and calcium was evaluated. Coagulation-rate experiments coupled with measurements of particle-size distribution were performed with suspensions of alumina particles containing varied concentrations of humic material, calcium, and ozone. It was observed that calcium increased susceptibility to ozone-induced colloid destabilization. The concentration of ozone required for particle destabilization is a function of the organic carbon concentration as well as the calcium concentration. Experiments without ozonation showed that suspensions with higher concentrations of calcium and lower concentrations of humic material coagulate more readily than suspensions of lower concentrations of calcium or higher concentrations of humic material. Electrophoretic mobility measurements were consistent with the observed trends in particle destabilization as determined by orthokinetic-coagulation-rate experiments. Three-dimensional plots that illustrated changes in the volume distribution of particles with time supported the validity and usefulness of the collision efficiency factor as calculated from the orthokinetic coagulation rate for monodisperse particles. (Author's abstract)
W89-12697

MEASUREMENT AND DISTRIBUTION OF DISSOLVED NUCLEIC ACIDS IN AQUATIC ENVIRONMENTS.

Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 7B.
W89-12703

MAJOR ION CHEMISTRY OF THE GANGA-BRAHMAPUTRA RIVER SYSTEM: WEATHERING PROCESSES AND FLUXES TO THE BAY OF BENGAL.
Physical Research Lab., Ahmedabad (India).
For primary bibliographic entry see Field 2J.
W89-12760

INORGANIC CHEMISTRY OF PEAT FROM THE MAUNACHIRA CHANNEL-SWAMP SYSTEM, OKAVANGO DELTA, BOTSWANA.
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Geology and Botany.
For primary bibliographic entry see Field 2H.
W89-12761

MANGANESE INHIBITION OF MICROBIAL IRON REDUCTION IN ANAEROBIC SEDIMENTS.
Geological Survey, Reston, VA. Water Resources Div.
D. R. Lovley, and E. J. P. Phillips.
Geomicrobiology Journal GEJODG, Vol. 6, No. 3/4, p 145-155, 1988. 2 fig, 1 tab, 37 ref.

Descriptors: *Sediments, *Aquatic bacteria, *Iron reduction, *Manganese, *Geochemistry, Bacteria, Interstitial water, Anaerobic conditions, Chemical reactions.

Potential mechanisms for the lack of Fe(II) accumulation in Mn(IV)-containing anaerobic sediments were investigated. The addition of Mn(IV) to sediments in which Fe(III) reduction was the terminal electron-accepting process removed all the pore-water Fe(II), completely inhibited net Fe(III) reduction, and stimulated Mn(IV) reduction. In a solution buffered at pH 7, Mn(IV) oxidized Fe(II) to amorphic Fe(III) oxide. Mn(IV) naturally present in oxic freshwater sediments also rapidly oxidized Fe(II). A pure culture of a dissimilatory Fe(II)-and Mn(IV)-reducing organism isolated from the sediments reduced Fe(III) to Fe(II) in the presence of Mn(IV) when ferrozine was present to trap Fe(II) before Mn(IV) oxidized it. Depth profiles of dissolved iron and manganese reported in previous studies suggest that Fe(II) diffusing up from the zone of Fe(III) reduction is consumed within the Mn(IV)-reducing zone. These results demonstrate that preferential reduction of Mn(IV) by Fe(III)-reducing bacteria cannot completely explain the lack of Fe(II) accumulation in anaerobic, Mn(IV)-containing sediments, and indicate that Mn(IV) oxidation of Fe(II) is the mechanism that ultimately prevents Fe(II) accumulation. (Author's abstract)
W89-13029

OPEN-INCUBATION, DIFFUSION METHODS FOR MEASURING SOLUTE REACTION RATES IN SEDIMENTS.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
R. C. Aller, and J. E. Mackin.
Journal of Marine Research JMMRAO, Vol. 47, No. 2, p 411-440, May 1989. 19 fig, 1 tab, 31 ref, 2 append.

Descriptors: *Water chemistry, *Sediments, *Chemical reactions, *Diagenesis, *Interstitial water, *Solutes, *Laboratory methods, *Diffusion, *Kinetics, Ammonium, Sulfates, Phosphates, Iodides, Manganese, Iron.

Sedimentary solute distributions and fluxes are determined in part by the kinetics of production/consumption reactions in a deposit. It is possible to estimate rates and investigate kinetic relations in undisturbed or manipulated sediments by documenting build-up or depletion patterns of solutes allowed to diffuse either between relatively thin sections of sediment and a well-stirred water reservoir (plug incubation), or through a large section of sediment without an overlying reservoir (whole-core incubation). The time-dependent concentrations in the sediment in both cases depend on reaction rates, kinetics, diffusion coefficients, and geometric scaling of the sediment and contacting reservoir. Major advantages of the plug incubation method are that interactions between classes of sedimentary reactions can be examined by manipulating the composition of the stirred water reservoir, and kinetic relations, e.g., reaction order, can be inferred from comparisons of reaction rate with steady-state concentrations of pore water solutes. The water reservoir size and sediment thickness can be altered to allow rapid estimates of reaction rates at near steady-state or to examine nonsteady-state behavior. Nonsteady-state models are always required for the whole-core incubation method, which has the advantages that it is less labor-intensive than many other rate measurement methods and the incubations can be performed in situ. Experimental comparisons between open-incubation and more traditional closed-incubation estimates of reaction rates show good agreement for solutes such as HN4(+), SO4(–), HPO4(-) and I(-). In some cases, e.g., Mn(++), Fe(++), and HPO4(-) production, where major back-reactions with sediment occur, open-incubations without substantial build-up of solutes may provide the most accurate method for estimating production rates. In principle, the open incubation methods described can be used for any diffusable species. (Author's abstract)
W89-13038

GROUNDWATER CONTAMINATION WITH ARSENIC AND OTHER TRACE ELEMENTS IN AN AREA OF THE PAMPA, PROVINCE OF CORDOBA, ARGENTINA.
Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina). Dept. de Geoquimica y de Aplicaciones Geologicas de la Teleobservacion.
For primary bibliographic entry see Field 5B.
W89-13111

WATER PHYSICS AND CHEMISTRY.
L. Saunders.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 50-66, 4 tab, 9 fig, 3 ref.

Descriptors: *Water chemistry, *Water properties, *Physical properties, *Chemical properties, *Molecular structure, Solvents, Hydrogen ion concentration, Colloids, Compressibility, Electrolytes, Bonding, Oxidation-reduction potential.

This is a review of the chemistry and physics of water. Atomic and molecular structures are discussed with an emphasis on the composition of water. Specific properties of water reviewed include ionic dissociation, pH, phase equilibria, compressibility, solvent properties, and colloids. Electrovalent bonds, electrolytes, and oxidation/reduction in water also are covered. (See also W89-13208) (Hammond-PTT)
W89-13210

NATURAL WATERS.
University Coll., London (England).
G. Solt.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 67-83, 2 tab, 1 fig.

Descriptors: *Water chemistry, *Water treatment, *Natural waters, *Cost analysis, *Separation techniques, *Suspended solids, *Dissolved solids, Pretreatment of water, Filtration, Ultrafiltration, Distillation, Ion exchange, Reverse osmosis, Disinfection, Electrodialysis, Deep wells, Mountain lakes, Surface water, Brackish water, Seawater, Wet climates, Tropical regions, Water treatment facilities.

The classes of suspended and dissolved impurities found in natural waters are discussed. The types of water studied include deep well, moorland, mountain, surface, wet tropical zones, brackish and sea water. Some purification processes used in removing a wide range of impurities include filtration, distillation, ion exchange, electrodialysis, reverse osmosis and ultrafiltration, and disinfection and sterilization. The purification processes all require pre-treatment for the removal of suspended particles. The combination of membrane processes with deionization presents a system of immense potential: waters with a wide range of impurities can be purified with this combined technology to produce ultra-pure water suitable for the most critical applications. Natural waters discussed here have displayed at least one common factor: a very low impurity level. Water treatment plants, therefore are designed to remove very small quantities of dissolved contaminants at very low concentration from a large volume of water with a high degree of efficiency in terms of percentages removal and economy. In water purification we incur two kinds of costs: (1) movement of water through the plant. Except in reverse osmosis they are quits small per cubic meter. (2) the cost of the actual purification is also small. This cost is not only related to the concentration of the dissolved solids in the water but also depends on the desired quality of the end-product: the treated water. In the removal of dissolved solids, the purification cost is by far the more important. Deionization from a town water supply of 250 to ppm TDS will consume about 750 g in chemicals per ton of water, which results in a uniquely low price for any purification process in the whole range of chemical industries. This usage of chemicals can be though of as a consumption of 750 g of chemicals to remove 250 g of dissolved solids, or 3 g per g. Improving the 1 ppm end-product water to obtain ultra-pure water of less than 0.1 ppm TDS would probably cost 50 percent more, the increased cost reflecting the greater difficulty of working at very purity levels. (See also W89-13208) (Hammond-PTT)
W89-13211

WATER QUALITY DATA (OCTOBER 1987 THROUGH SEPTEMBER 1988) AND STATISTICAL SUMMARIES (MARCH 1985 THROUGH SEPTEMBER 1988) FOR THE CLARK FORK AND SELECTED TRIBUTARIES FROM GALEN TO MISSOULA, MONTANA.
Geological Survey, Helena, MT. Water Resources Div.
J. H. Lambing.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-229, 1989. 51p, 30 fig, 7 tab, 12 ref.

Descriptors: *Trace elements, *Water quality, *Clark Fork, *Montana, Streamflow, Suspended sediments.

Water quality sampling was conducted at eight sites on the Clark Fork and selected tributaries from Galen to Missoula, Mont., from October 1987 through September 1988. This report presents tabulations and statistical summaries of the water quality data. Included in this report are tabulations of streamflow, onsite water quality, and concentrations of trace elements and suspended sediment for periodic samples. Also included are tables and hydrographs of daily mean values for streamflow, suspended-sediment concentration, and suspended-sediment discharge at three mainstream stations and one tributary. Statistical summaries are presented for periodic water quality data collected from March 1985 through September 1988. Selected data are illustrated by graphs showing median concentrations of trace elements in water, relation of trace element concentrations to suspended-sediment concentrations, and median concentrations of trace elements in suspended sediments. (USGS)
W89-13347

INVESTIGATION OF THE STRUCTURAL FEATURES AND INTERACTIONS OF AQUATIC FULVIC ACIDS IN SURFACE AND GROUNDWATER.
North Texas State Univ., Denton. Inst. of Applied Sciences.
F. Y. Saleh, W. Ong, I. Kim, Q. H. Mahmoud, and D. Y. Chang.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-193429/AS. Price codes: A15 in paper copy, A01 in microfiche. Final Report, (1989). 232p, 71 fig, 15 tab, 42 ref, append. Contract 14-08-0001-G1146.

Descriptors: *Analytical techniques, *Fulvic acids, *Spectroscopy, *Chemical properties, *Chromatography, Chemical analysis, Aqueous solutions, Separation techniques, Molecular structure, Copper complexes, Tetrachlorobenzene, Fractionation.

Structural features and interactions of aquatic fulvic (FA) were investigated by combined chromatographic and spectroscopic techniques. Analytical and preparative reversed-phase liquid chromatograph were used to separate constituents of FA. Photodiode array, ultraviolet, and fluorescence detectors were used to monitor the HPLC separation. Preparative FA fractions were subjected to 1H and 13C solid state NMR, FT-IR and ESR as well as other separation and derivatization techniques. Fulvic acid interactions with Cu(2+) and tetrachlorobenzene isomers were investigated by ESR and HPLC and GC-MS. A catalogue of the uv-vis scans of FA constituents was developed using RP-HPLC under different mobile phases and gradient programs. The overall results indicate that: (1) FA macromolecule consists of a molecular complex which can be separated into three to six subunits; (2) Each subunit may contain two or three structurally related compounds; (3) Vanillic acid, conjugated ketones and phenols represent the backbone structures in FA; (4) The free radical in FA regulates the transformations of 1,2,4,5 TCB in aqueous solution but does not influence its aqueous solubility; (5) At least four binding sites in FA participate in complexation with Cu (2+). The first available sites are those participating in square planar complexes. (USGS)
W89-13357

GROUNDWATER QUALITY ASSESSMENT OF THE DELMARVA PENINSULA, DELAWARE, MARYLAND, AND VIRGINIA--ANALYSIS OF AVAILABLE WATER QUALITY DATA THROUGH 1987.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-13366

RADIONUCLIDES IN GROUNDWATER AT THE IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO.
Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-13377

2L. Estuaries

EXCHANGE OF NITROGEN, PHOSPHORUS, AND ORGANIC CARBON BETWEEN TRANSPLANTED MARSHES AND ESTUARINE WATERS.
North Carolina State Univ. at Raleigh. Dept. of Botany.
C. B. Craft, S. W. Broome, and E. D. Seneca.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 206-211, April/June 1989. 2 fig, 5 tab, 52 ref.

Descriptors: *Cycling nutrients, *Estuaries, *Marshes, *Nitrogen, *Phosphorus, *Organic carbon, Flooding, North Carolina, Phosphates, Ammonium, Soil organic matter.

Fluxes of N, P and organic C were measured between irregularly flooded transplanted marshes and estuarine waters at two sites in North Carolina. Hydrologic flux was regulated by pumping estuarine water into the marsh, holding the water for 24 hours, and pumping the water out. Samples were collected from waters flowing into and out of each of marsh and analyzed for salinity, N, P, and organic C. Concentrations of dissolved organic C were significantly higher in water flowing out of the two transplanted marshes compared to concentrations in inflow waters. In contrast, inflow waters contained significantly higher concentrations of phosphate than outflow waters. Phosphate flux was seasonal with maximum uptake by the marsh during the summer. Estimates of nutrient fluxes indicate that transplanted marshes export dissolved organic C 93-48 mmol/sq m/event) and N (0.2-5.6) and import ammonium (300-600 micromol/sq m/event) and phosphate (300-1000). The transplanted marshes are young communities that lack the large soil organic matter reservoirs and reducing environment characteristic of many natural marshes. These systems probably will continue to import ammonium and phosphate until the soils become reduced and soil nutrient reservoirs develop. (Author's abstract)
W89-12183

EFFECTS OF SALINE FLUSHING TO A POLLUTED ESTUARY TO ENHANCE WATER QUALITY STANDARDS.
Deakin Univ., Melbourne (Australia). Div. of Biological and Sciences.
For primary bibliographic entry see Field 5G.
W89-12225

REVIEW OF WATER QUALITY AND MANAGEMENT PROBLEMS IN CANAL ESTATES IN WESTERN AUSTRALIA.
Waterworks Commission, Perth (Australia).
For primary bibliographic entry see Field 5C.
W89-12233

INCOMPATIBLE RECREATION-ORIENTED BENEFITS IN A RESIDENTIAL TIDAL CANAL ESTATE AND MARINA, VICTORIA (AUSTRALIA).
Deakin Univ., Melbourne (Australia). Div. of Biological and Sciences.
For primary bibliographic entry see Field 6B.
W89-12242

SEASONAL DYNAMICS OF BENTHIC DIATOMS ON SOLID SUBSTRATES OF THE SEVASTOPOL BAY (SEZONNAYA DINAMIKA BENTOSN'IKH DIATOMOV'IKH VODOROSLEI NA TVERD'IKH SUBSTRATAKH SEVASTOPOL'SKOI BUKHTY).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
For primary bibliographic entry see Field 2H.
W89-12250

METABOLISM OF A FOULING COMMUNITY. COMMUNICATION 1. DYNAMICS OF SPECIES COMPOSITION, BIOMASS, MICROHETEROTROPHS AND POB IN THE MEDIUM WITH A COMMUNITY AT DIFFERENT STAGES OF ITS FORMATION (METABOLIZM SOOBSHCHESTVA OBRASTANIL SOOBSHCHENIE I. DINAMIKA VIDOVOGO SOSTAVA, BIOMASSY MIKROGETEROTROFOV I P.O.B. V SREDE S SOOBSHCHESTVOM NA RAZNYKH STADIYAKH EGO FORMIROVANIIA).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
V. A. Tamozhnyaya, S. A. Goromosova, A. Z. Shapiro, L. Kovalchuk, and O. A. Shakhmatova.
Ekologiia Moria, Vol. 30, p 36-45, 1988. 3 fig, 2 tab, 13 ref. English summary.

Descriptors: *Fouling, *USSR, *Water pollution effects, *Sevastopol Bay, *Species composition, Succession, Mollusks, Seasonal variation.

The dynamics of the formation of a fouling community was observed in Sevastopol Bay in the Black Sea for 20 months. The evolution of the community proceeds through three stages whose duration is specified by domination of the microorganisms first, then by the Obelia loveni hydroid population, colonial Botryllus schlosseri Ascidia, and finally by the bivalved Mytilus galloprovincialis mollusks. There are three phases in the development of each stage: young, mature, and degenerating communities, each with different metabolic characteristics. The numbers of heterotrophic bacteria in the medium decrease for the first 2 hours of exposure and continue decreasing during the day, except for the summer period when botrilli predominate and for the spring period, a period of mussel reproduction. Maxima of heterotroph numbers coincide with soluble organic matter (POB) maxima, the correlation increasing with hypoxia (r=0.7-0.8). (Author's abstract)
W89-12251

PHOSPHATE CONSUMPTION BY DIFFERENT DIMENSIONAL FRACTIONS OF A MICROPLANKTONIC COMMUNITY IN THE MEDITERRANEAN (POTREBLENIE FOSFATOV RAZLICHNYMI RAZMERIYMI FRAKTSIIAMI MIKROPLANKTONNOGO SOOBSHCHESTVA V SREDIZEMNOM MORE).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
For primary bibliographic entry see Field 2H.
W89-12252

CONSUMPTION OF INORGANIC PHOSPHORUS BY DIFFERENT DIMENSIONAL GROUPS OF MICROPLANKTON IN SEVASTOPOL BAY (POGLOSHCHENIE NEORGANICHESKOGO FOSFORA RAZLICHNYMI RAZMERNYMI GRUPPAMI MIKROPLANKTONA V SEVASTOPOL'SKOI BUKHTE).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
M. V. Kirikova.
Ekologiia Moria, Vol. 30 p 50-54, 1988. 1 fig, 1 tab, 11 ref. English summary.

Descriptors: *Nutrients, *USSR, *Phosphates, *Sevastopol Bay, *Plankton, Cycling nutrients, Fate of pollutants, Seasonal variation.

A quantitative estimation was made for the contribution of large (2.5-150 microm) and small (0.45-2.5 microm) forms of microplankton to the total consumption of inorganic phosphorus with seasonal variations in its content in Sevastopol Bay. Small forms of microplankton accounted for an appreciable amount (50%) of the total phosphorus consumed during the observation period. The consumption of inorganic phosphorus by the small fraction of microplankton is limited by a lower concentration of phosphates as against the large fraction. (Peters-PTT)
W89-12253

ACCUMULATION AND FIXATION OF VARIOUS FORMS OF STABLE AND RADIOACTIVE SULPHUR BY THE BLACK SEA ALGAE (NAKOPLENIE I FIKSATSIIA RAZLICHNYKH FORM STABILVNOI I RADIOAKTIVNOI SERY CHERNOMORSKIMI VODOROSLIAMI) (IN RUSSIAN).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
For primary bibliographic entry see Field 2H.
W89-12254

STUDY OF SOME PHYSICAL-CHEMICAL PARAMETERS IN THE GHAR EL MELH LAGOON (ETUDE DE QUELQUES PARAMETRES PHYSICO-CHIMIQUES DE LA LAGUNE DE GHAR EL MQELH).
Institut National Agronomique de Tunis (Tunisia). Dept. Halieutique.
F. Ktari-Chakroun, and M. S. Romdhane.
Bulletin de l'Institut National Scientifique et Technique d'Oceanographie et de Peche BNSSEE, Vol. 12, p 25-51, 1985. 12 fig, 2 tab, 20 ref. English summary.

Descriptors: *Ghar el Melh Lagoon, *Salinity, *Temperature, *Dissolved oxygen, Climate effects, Tunisia.

From October 1980 to September 1981, a study of temporal and spatial evolution of the temperature, the salinity and the dissolved oxygen, in Ghar El Melh lagoon, includes the climatic influence on the variation of these parameters. (Author's abstract)
W89-12255

MACROBENTHOS IN THE COASTAL ZONE OF THE BLACK SEA AFTER CESSATION OF WASTE DISCHARGE (MAKROBENTOS PRIBREZHNOI ZONY CHERNOGO MORYA

POSLE PREKRASHCHENIYA SBROSA STOCHNYKH VOD).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
For primary bibliographic entry see Field 5G.
W89-12268

STATISTICAL ANALYSIS OF THE HYDROMETEOROLOGICAL ELEMENTS AND THEIR EFFECT ON THE SALINITY, BIOGENIC MATTER AND PRIMARY PRODUCTION OF ORGANIC MATTER IN THE SEA OF AZOV (STATICHESKII ANALIZ VLIIANIIA GIDROMETEOROLOGICHESKIKH ELEMENTOV NA SOLENOST' BIOGENNYE VESHCTESTVA I PERVICHNUIU PRODUKTSIIU V AZOVSKOM MORE).
Azovskii Nauchno-Issledovatel'skii Inst. Rybnogo Khozyaistva, Rostov-na-Donu (USSR).
U. M. Gargona.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 6, p 63-67, 1988. 1 tab, 11 ref. English summary.

Descriptors: *Azov Sea, *Statistical analysis, *Meteorology, *River flow, *USSR, *Model studies, Temperature effects, Wind, Primary productivity, Forecasting, Optimization, Mathematical models, Statistical models.

Physicochemical and hydrobiologic characteristics of the Azov Sea are formed by river flow interacting with the temperature and the wind. Statistical models describe the dependence of long-term salinity fluctuations, biogenic elements and primary production of organic matter in the Azov Sea on abiotic factors fairly adequately. The accuracy and effectiveness of the methods suggested are good or satisfactory. The equations developed are useful in forecasting, management and optimization of the Azov Sea ecosystem. (Author's abstract)
W89-12276

SALT AND GAS CONDITIONS IN THE TILIGULIAN ESTUARY (SOLEVOI I GAZOVYI REZHIM TILIGUL'SKOGO LIMANA).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
L. A. Zhuravleva, and A. A. Polov'ian.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 6, p 67-72, 1988. 1 fig, 2 tab, 8 ref. English summary.

Descriptors: *USSR, *Tiligulian Estuary, *Estuaries, *Meteorological effects, Salinity, Black Sea, Dissolved oxygen, Hydrogen ion concentration, Seasonal variation.

Hydrometeorological conditions in the Tiligulian Estuary located at the north-western coast of the Black Sea and the vital activity of its plant and animal organisms are determining factors for the formation of salt and gas conditions of the estuary. Depending on the action of these factors, biochemical and hydrodynamic processes predominate, which stipulate the content, distribution and seasonal dynamics of water salinity, ionic composition, dissolved oxygen, carbon dioxide and pH of the water. (Author's abstract)
W89-12277

DENITRIFICATION AND NITROGEN FIXATION IN THE SEDIMENTS OF VOSTOK BAY OF THE SEA OF JAPAN (DENITRIFIKATSIIA I AZOTFIKSATSIIA B OSADKAKH ZALIVA VOSTOK IAPONSKOGO MORIA).
Akademiya Nauk SSSR, Vladivostok. Inst. Biologii Morya.
For primary bibliographic entry see Field 5B.
W89-12285

MICROHETEROTROPHIC ACTIVITY IN A SUBANTARCTIC INTERTIDAL SEDIMENT RELATIVE TO NUTRIENT SUPPLY.
Centre de Recherches Oceanographiques, Abidjan (Ivory Coast).
For primary bibliographic entry see Field 2J.
W89-12290

MEASURED AND MODELLED EFFECTS OF TEMPERATURE, DISSOLVED OXYGEN AND NUTRIENT CONCENTRATION ON SEDIMENT-WATER NUTRIENT EXCHANGE.
Virginia Inst. of Marine Science, Gloucester Point. C. F. Cerco.
Hydrobiologia HYDRB8, Vol. 174, No. 3, p 185-194, April 22, 1989. 3 fig, 3 tab, 30 ref. NSF grant CEE-8307627.

Descriptors: *Model studies, *Temperature effects, *Dissolved oxygen, *Nutrients, *Cycling nutrients, *Estuaries, *Sediment-water interfaces, Nutrient exchange, Ammonium, Nitrates, Phosphates, Water temperature, Mathematical models, Chesapeake Bay, Gunston Cove, Virginia.

Empirical models of sediment-water fluxes of NH4(+), NO3(-) and PO4(3-) were performed based on published reports. The models were revised and parameters evaluated based on laboratory incubations of sediments collected from Gunston Cove, VA. Observed fluxes ranged from -18 (sediment uptake) to 276 (sediment release) mg NH4(+)/sq m/day, -17 to -509 mg NO3(-)/sq m/day, and -16.4 to 8.9 mg PO4(3-)/sq m/day. The model and observations indicated release of NH4(+) was enhanced by high temperature and by low dissolved oxygen (DO). Uptake of NO3(-) was enhanced primarily by high NO3(-) concentration and to a lesser extent by high temperature and by low DO. Direction of PO4(3-) flux depended on concentration in the water. Release was enhanced by low DO. No effect of temperature on PO4(3-) flux was observed. (Author's abstract)
W89-12303

EFFECTS OF BOTTLE SIZE IN DETERMINATIONS OF PRIMARY PRODUCTIVITY BY PHYTOPLANKTON.
University Coll. of North Wales, Menai Bridge. School of Ocean Sciences.
For primary bibliographic entry see Field 7B.
W89-12310

FRESHWATER FLOW FROM THE EVERGLADES TO FLORIDA BAY: A HISTORICAL RECONSTRUCTION BASED ON FLUORESCENT BANDING IN THE CORA SOLENASTREA BOURNONI.
Australian Inst. of Marine Sciences, Townsville.
For primary bibliographic entry see Field 2E.
W89-12357

DISTRIBUTION, ABUNDANCE AND PRODUCTIVITY OF SEAGRASSES AND MACROALGAE IN FLORIDA BAY.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. C. Zieman, J. W. Fourqurean, and R. L. Iverson.
Bulletin of Marine Science BMRSAW, Vol. 44, No. 1, p 292-311, January 1989. 12 fig, 5 tab, 28 ref. Southeast Research Center of the Everglades National Park grant CX5280-2-2204, NSF grant OCE-77-27051-02.

Descriptors: *Estuaries, *Primary productivity, *Aquatic plants, *Florida Bay, *Aquatic productivity, *Sea grasses, Population density, Macrophytes, Algae, Biomass, Standing crop.

The distribution, abundance, and productivity of submerged macrophytes were measured in Florida Bay to determine the total productivity and seagrass habitat distribution throughout the region. Thalassia testudinum was widely distributed and was the dominant macrophyte species in the 1,660 sq km of seagrass beds contained in the bay. Halodule wrightii was also common, but had standing crop significantly less than Thalassia at all sample locations. Syringodium filiforme grew mainly in areas with strong oceanic influence, especially along the south and west margins of the bay. Macroalgae were a small percentage of the total macrophyte biomass. Gradients in environmental and biological variables extended from southwest to northeast Florida Bay. Water clarity, water exchange, and sediment depth were all greatest in the south and west portion of the bay and decreased toward the northeast corner of the bay. The seagrass standing crop varied from between 60 and 125 g dw/sq m in the southwest to between 0 and 30 g dw/sq m in the northeast. Total seagrass leaf standing crop was 8 times 10 to the 10th g dw in Florida Bay, 90% of which was Thalassia leaf material. Thalassia mean leaf productivity was 0.97 g dw/sq m-d, with higher values in the southwest and lower values in the northeast portions of the bay. Approximately 1.7 times 10 to the 9th g dw/d of Thalassia leaf tissue was produced in Florida Bay during the summer. Thalassia had about the same leaf productivity on a per gram leaf dry weight basis throughout the different environments of Florida Bay, therefore variations in areal leaf productivity were caused by variations in leaf standing crop and not by variations in leaf specific productivity. Distribution, abundance, and productivity data were used to divide the bay into six community types. (Author's abstract)
W89-12358

MACROALGAL PRODUCTION AND NUTRIENT RELATIONS IN OLIGOTROPHIC AREAS OF FLORIDA BAY.
Harbor Branch Oceanographic Institution, Inc., Fort Pierce, FL.
B. E. Lapointe.
Bulletin of Marine Science BMRSAW, Vol. 44, No. 1, p 312-323, January 1989. 6 fig, 2 tab, 48 ref. NSF grant OCE-8515492.

Descriptors: *Estuaries, *Florida Bay, *Primary productivity, *Aquatic productivity, *Cycling nutrients, *Limiting nutrients, *Growth rates, Ecosystems, Nitrogen, Phosphorus, Oligotrophy, Bays, Aquatic plants, Algae, Macrophytes.

Abundant macroalgae of southern Florida Bay were assayed for nitrogen (No and phosphorus (PO) limitation of productivity by enrichment effects on in situ growth rate, tissue C:N:P molar ratios, and capacity of alkaline phosphatase. Growth of two frondose rhodophytes, Gracilaria tikvahiae and Laurencia poitei, was stimulated primarily by P (although N was also limiting during winter) as was growth of two frondose phaeophytes, Sargassum polyceratium and Sargassum pteropleuron. Tissue C:P and N:P ratios of the unenriched rhodophytes were elevated, ranging from 1,080 to 1,939 and 75 to 147, respectively; C:P and N:P ratios of the unenriched phaeophytes were lower, ranging from 550 to 1,307 and 23 to 25, respectively. These tissue ratios support the primary P limitation suggested by the growth assays and suggest that phylogenetic differences may exist in storage and utilization of N and P compounds relative to C. Levels of dissolved inorganic nutrients (NH4(+), NO3(-), and PO4(3-)) in seawater during these studies also suggest that P, relative to N, was most limiting during summer months when NO3(-) and NH4(+) were seasonally elevated and seawater N:P ratios were $>$ 30:1. Assays for alkaline phosphatase activity in phylogenetically diverse forms of Florida Bay macroalgae indicated broadly different capacities of this exoenzyme, with the highest rates observed for Dictyota divaricata and L. poitei and the lowest rates for G. tikvahiae. Considering that D. divaricata and L. poitei had the greatest observed capacity for this enzyme and that these and related species are particularly abundant in southern Florida Bay, utilization of dissolved organic phosphate pools appears to be ecologically important to sustaining productivity of indigenous frondose macroalgae in P-limited Florida Bay. (Author's abstract)
W89-12359

EXPERIMENTAL EVIDENCE FOR NUTRIENT LIMITATION OF SEAGRASS GROWTH IN A TROPICAL ESTUARY WITH RESTRICTED CIRCULATION.
National Audubon Society, Tavernier, FL. Research Dept.
G. V. N. Powell, W. J. Kenworthy, and J. W. Fourqurean.
Bulletin of Marine Science BMRSAW, Vol. 44, No. 1, p 324-340, January 1989. 7 fig, 2 tab, 56 ref.

Descriptors: *Estuaries, *Sea grasses, *Cycling nutrients, *Limiting nutrients, *Florida Bay, *Tropical regions, Waterfowl, Tidal flats, Marine environment, Standing crop, Biomass, Phosphates.

The impacts of additions of nutrients to a seagrass community on a carbonate mud bank in Florida Bay were studied. Shallow mud banks dampen lunar tide in Florida Bay, and impoundment and channelization of the upland watershed (the Everglades) have reduced freshwater input, resulting in restricted circulation and reduced nutrient availability. Nutrients were supplied by seabirds defecating from experimental roosts. Seabirds used the roosts 87% of the time so the input of nutrients was constant and quantifiable. The birds delivered approximately 2-4 g of excrement per day, resulting in an average loading rate of 0.052 gN and 0.0009 gP/sq m-d. Only a portion of the excrement is immediately released as inorganic NH3, and PO4(-); about 80% reaches the sediment surface in a relatively insoluble form. There was a significant buildup of phosphate and ammonium in the pore water at the enriched sites. The ammonium profile of low concentrations at the surface and then increasing with a steep slope through 20 cm suggests a rapid uptake and demand for mineralized nitrogen. Phosphorus, in contrast, had relatively high levels at the surface. Nutrient addition significantly increased areal leaf production and standing crop of Thalassia testudinum and Halodule wrightii. Above ground biomass at enriched sites averaged twice controls while below ground biomass was not significantly different between fertilized and control plots. Increased standing crop was produced primarily through longer, wider blades by Thalassia and longer blades and increased short shoot density by Halodule. Thalassia areal leaf production was 60% greater at enriched sites than at controls. Halodule areal leaf production increased by three orders of magnitude at enriched sites. Tissue nutrient content and nitrogen fixation assays suggest that phosphorus availability limits seagrass growth in unenriched conditions, but that nitrogen becomes limiting with the addition of bird excrement. (Author's abstract)
W89-12360

OVERVIEW OF ECOLOGY OF MANGROVES AND INFORMATION NEEDS FOR FLORIDA BAY.
Rosenstiel School of Marine and Atmospheric Science, Miami, FL. Div. of Biology and Living Resources.
S. C. Snedaker.
Bulletin of Marine Science BMRSAW, Vol. 44, No. 1, p 341-347, January 1989. 1 fig, 1 tab, 33 ref.

Descriptors: *Ecology, *Ecosystems, *Estuaries, *Mangrove swamps, *Marine environment, *Florida Bay, *Coastal marshes, Bays, Forests, Dissolved organic matter, Cycling nutrients, Aquatic habitats.

The mangrove forest areas bordering Florida Bay have provided research data and information that have formed the bases both for conservation laws and for the advances in mangrove research at other laboratories throughout the world. In this regard, the structural diversity of Florida Bay mangroves has been reasonably documented, but little research has been done on functional diversity, particularly, as it relates to the nearshore estuarine flora and fauna. What is already known about Florida Bay's coastal forest habitats is reviewed, and that which remains to be researched is outlined for mangrove-habitat diversity and the functional diversity among the mangrove habitats. It is postulated that the quantity, quality and timing of fluxes of dissolved organic matter (DOM) from different mangrove forest types may have a significant regulatory or control role in the structure and functioning of estuarine populations. At least three distinct roles for DOM are postulated: (1) as an alternate food source, (2) as the basis for heterotrophic microorganism food webs, and (3) as a source of chemical cues controlling the spatial and temporal distribution of estuarine species. This postulation focuses on a new area in chemical ecology that could lead to important new research findings on the interrelationships between mangrove forest habitats and the biological organization of estuarine communities. (Friedmann-PTT)
W89-12361

SEDIMENT, WATER LEVEL AND WATER TEMPERATURE CHARACTERISTICS OF FLORIDA BAY'S GRASS-COVERED MUD BANKS.
Florida State Univ., Tallahassee. Dept. of Biological Science.
J. G. Holmquist, G. V. N. Powell, and S. M. Sogard.
Bulletin of Marine Science BMRSAW, Vol. 44, No. 1, p 348-364, January 1989. 11 fig, 5 tab, 36 ref.

Descriptors: *Estuaries, *Coastal marshes, *Water level, *Water temperature, *Florida Bay, *Mud flats, *Marine sediments, Wind, Tidewater, Tidal effects, Species diversity, Aquatic plants, Sea grasses.

Florida Bay is a shallow lagoonal estuary divided into basins by a latticework of mud banks, which exert a disproportionate influence on the bay ecosystem. Prevailing northeasterly winds resulted in distinct sheltered and exposed sides on narrow banks, the former with fine and low organic content. Bank water levels were highest in fall. Lunar tidal flux appeared to be directly related to the degree of access to open ocean for any given site. Water levels also demonstrated some degree of wind-dependency at all sites. Although water levels on narrow banks were highly correlated with those of basins, one 2-km-wide bank retained a lens of water at low tide despite lower levels in adjacent basins. Bank temperatures ranged from 7.5 C to 37.0 C and demonstrated a mean daily range of 4.5 C, but up to 15 C, in contrast to basin ranges of 1-2 C. Temperature range was a function of air temperature range and water level. September through November was the most benign period on the banks. A bank in the northeastern bay was the physically severest of the six study sites. For bank organisms, the scenario described sets the stage for web-like interactions between a variety of physical parameters. Water level, for instance, is a function of oceanic level, lunar rhythm, wind, and seagrass growth and, in turn, influences sediment properties, water temperature, seagrass richness, and animal community structure. Organisms inhabiting deeper seagrass beds are not subject to the same degree of physical stress as those living on a mud bank. (Friedmann-PTT)
W89-12362

BIOGENIC CARBONATE PRODUCTION IN FLORIDA BAY.
Royal Holloway and Bedford New Coll., Egham (England). Dept. of Geology.
D. Bosence.
Bulletin of Marine Science BMRSAW, Vol. 44, No. 1, p419-433 , January 1989. 4 fig, 7 tab, 30 ref.

Descriptors: *Estuaries, *Florida Bay, *Aquatic productivity, *Aquatic animals, *Carbonates, Zooplankton, Mollusks, Growth rates, Ecosystems, Bays, Marine environment, Aquatic environment.

Previous work on biogenic carbonate production within Florida Bay is reviewed. New data on production from the Upper Cross Bank and Buchanan Key areas are presented. Production figures for bank and lake environments are calculated from standing crop surveys and growth rates determined from published work and short-term growth measurements. The organisms studied were: Porites, Thalassia, epibionts, mollusks, Penicillus, soritid foraminifera and Halimeda, listed in order of decreasing carbonate productivity. Production figures indicate that banks produce twice as much skeletal carbonate per unit area as lakes. However, lakes are much larger than banks and, within the study areas, lakes generate about four times the amount of sediment as that formed on banks. This excess sediment is considered to have been transported to the southwest of the bay to areas with larger constructional banks or out of the Florida Bay system. The migrating Upper Cross Bank generates sediment at rates nearly one order of magnitude less than those of the more stable Buchanan bank and the back-reef mound of Tavernier. Production rates may therefore be affecting bank stability. (See also W89-12364) (Author's abstract)
W89-12363

SURFACE SUBLITTORAL SEDIMENTS OF FLORIDA BAY.
Royal Holloway and Bedford New Coll., Egham (England). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W89-12364

ORIGIN, GROWTH AND EVOLUTION OF CARBONATE MUDBANKS IN FLORIDA BAY.
Rosenstiel School of Marine and Atmospheric Science, Miami, FL. Div. of Marine Geology and Geophysics.
H. R. Wanless, and M. G. Tagett.
Bulletin of Marine Science BMRSAW, Vol. 44, No. 1, p 454-489, January 1989. 19 fig, 1 tab, 42 ref.
NSF grant EAR-77-13707.

Descriptors: *Estuaries, *Florida Bay, *Carbonates, *Mud flats, *Paleolimnology, *Geologic history, *Geomorphology, *Stratigraphy, *Sea grasses, Geologic time, Succession, Evolution, Bays, Coastal marshes.

Between 4,500 and 3,000 years Before Present, rising sea level inundated the area now known as Florida Bay. Inundated and dissected coastal deposits then served as nuclei from which the present complex of Florida Bay islands, mudbanks, bank spits and bays evolved. Portions of the islands are the result of supratidal progradation across younger mudbank buildups. Marine mudbanks nucleated on inundated coastal levees and mangrove peats. Mudbank cores are composed of layered mudstone reflecting an early history dominated by physical sedimentation. There is, however, a striking lateral gradation in bank morphology, dynamics, and stratigraphy. Four such zones are identified: (1) Inner Destructional Zone in eastern Florida Bay, which has small, discontinuous erosional mudbanks with a grainstone veneer separated by rock-floored basins; (2) Central Migration Zone in central Florida Bay, which has an anastomozing maze of narrow, continuous banks dominated by layered mudstone sequences; (3) Western Constructional Zone, in the western Bay, which has very broad, actively expanding banks separated by shallow lakes containing about 1 m of molluscan wackestone; (4) Outer Destructional Zone, erosional bank remnants with layered mudstone cores surrounded by a barren Pleistocene limestone surface. Intense marine burrowing has destroyed some aspects of the transgressive depositional facies sequence in the bay and blurred evidence of physical sedimentation during the later stages of bank development. It is shown that seagrasses are now at a peak in their influence in Florida Bay's history, that they are episodically eliminated from much of the bay and that they have only had a minor to moderate influence on the mudbank evolution. (Author's abstract)
W89-12365

ACCUMULATION AND PERSISTENCE OF TRIBUTYLTIN IN EELGRASS (ZOSTERA MARINA L.) TISSUE.
New Hampshire Univ., Durham. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W89-12387

EROSION CONTROL STRATEGIES FOR BAY AND ESTUARINE BEACHES.
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
For primary bibliographic entry see Field 4D.
W89-12496

COASTAL ZONE DEVELOPMENT, UTILIZATION, LEGISLATION, AND MANAGEMENT IN CHINA.
China Inst. for Marine Development Strategy, Beijing.
For primary bibliographic entry see Field 4D.
W89-12497

LESSER SNOW GEESE AND THE NITROGEN ECONOMY OF A GRAZED SALT MARSH.
Toronto Univ. (Ontario). Dept. of Botany.
D. R. Bazely, and R. L. Jefferies.
Journal of Ecology JECOAB, Vol. 77, No. 1, p 24-34, March 1989. 3 fig, 1 tab, 43 ref.

Descriptors: *Salt marshes, *Food habits, *Nitrogen cycle, *Nutrients, *Sediments, Nitrate, Ammonium, Snow geese, Cyanophyta, Decomposition, Vegetation, Feedback systems, Subarctic zone.

The acetylene-reduction technique was used to measure nitrogenase activity of surface sediments of a subarctic salt marsh, in order to estimate whether at least some of the nitrogen of forage plants that is incorporated into body tissues of an herbivore (lesser snow goose, Chen caerulescens caerulescens) is replaced by nitrogen fixation. Nitrogenase activity was consistently higher in grazed plots compared with rates in ungrazed plots. Estimates of total amounts of nitrogen fixed in grazed plots between June and September ('melt to freeze-up') were approximately 1 g N/sq m. Unlike ungrazed swards, where plant litter accumulated, mats of cyanobacteria were present on the surface of sediments between individual plants. Levels of exchangeable and soluble ammonium and nitrate ions were measured in sediments in order to determine amounts of inorganic nitrogen available for plant growth. Levels of exchangeable and soluble ammonium ions were low (e.g. <6 micrograms exchangeable N-NH4/g dry wt sediment) throughout most of the growing season, but higher levels were detected in early spring and fall, particularly in grazed plots. Only trace amounts of nitrate ions were present in sediment extracts. A feedback model involving different aspects of the nitrogen cycle describes the strong interaction between the herbivore and salt marsh vegetation. The geese act on this ecosystem with high C/N ratios in the sediments by accelerating the breakdown and decomposition steps of the nitrogen cycle, thus providing a nitrogen source for forage species. Herbivory prevents the accumulation of litter which also allows cyanobacteria to colonize the sediment between grazed plants. The colonial foraging behavior of the geese, which leads to intense cropping, is essential for maintenance of existing plant communities dominated by preferred forage species. (White-Reimer-PTT)
W89-12500

MODEL OF THE PHOSPHORUS DYNAMICS OF CALLUNA HEATHLAND.
Institute of Terrestrial Ecology, Wareham (England). Furzebrook Research Station.
For primary bibliographic entry see Field 2I.
W89-12501

MEROMIXIS IN AN ANTARCTIC FJORD: A PRECURSOR TO MEROMICTIC LAKES ON AN ISOSTATICALLY RISING COASTLINE.
Department of Science, Kingston (Australia). Antarctic Div.
J. B. Gallagher, H. R. Burton, and G. E. Calf.
Hydrobiologia HYDRB8, Vol. 172, p 235-254, 1989. 10 fig, 3 tab, 36 ref.

Descriptors: *Antarctic, *Fjords, *Meromictic lakes, *Uplift pressure, *Limnology, *Geologic history, Holocene, Ellis Fjord, Vestfold Hills, Isotope studies, Saline water, Climate, Ice formation.

Physico-chemical data and isotopic studies (using H14CO3, H218O, and 3H2O) suggest that hypersaline meromixis in Ellis Fjord (Vestfold Hills, Antarctica) was initiated during the middle Holocene period, when saline brine, excluded during the annual formation of sea-ice, gravitated in a density current to the bottom. The application of this contemporary information to the genesis of meromictic lakes found today in the Vestfold Hills suggests that their meromixis may have developed prior to isolation from the sea. Comparison of physico-chemical data from the meromictic basins of Ellis Fjord with that of the Vestfold Hills saline lake allows some determination of their evolutionary pathways initiated before, during, and after isolation from the sea. Further evolution of each lake can be explained through the individual interactions among climate, catchment size, and basin morphology. (Author's abstract)
W89-12566

ESTUARINE TRANSPORT OF TRACE METALS IN A BUOYANT RIVERINE PLUME.
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 5B.
W89-12602

CARBON ISOTOPES AND FATTY ACIDS ANALYSIS OF THE SEDIMENTS OF NEGRO HARBOUR, NOVA SCOTIA, CANADA.
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W89-12604

TRACE METAL ASSOCIATIONS IN THE WATER COLUMN OF SOUTH SAN FRANCISCO BAY, CALIFORNIA.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W89-12605

MAPPING THE ECOLOGICAL IMPACT OF HEAVY METALS ON THE ESTUARINE POLYCHAETE NEREIS DIVERSICOLOR USING INHERITED METAL TOLERANCE.
Hull Univ. (England). Dept. of Applied Biology.
For primary bibliographic entry see Field 5G.
W89-12649

SEASONAL BIOTRANSFORMATION OF NAPHTHALENE, PHENANTHRENE, AND BENZO(A)PYRENE IN SURFICIAL ESTUARINE SEDIMENTS.
Massachusetts Univ. at Boston. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W89-12651

REGULATION OF BACTERIOPLANKTON PRODUCTION AND CELL VOLUME IN A EUTROPHIC ESTUARY.
Copenhagen Univ. (Denmark). Marine Biological Lab.
P. K. Bjornsen, B. Riemann, J. Pock-Steen, T. G. Nielsen, and S. J. Horsted.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 6, p 1512-1518, June 1989. 5 fig, 5 tab, 43 ref. Danish Natural Science Research Council and Danish EPA grants 11-4934 and 11-5573.

Descriptors: *Aquatic bacteria, *Plankton, *Productivity, *Estuaries, *Denmark, *Eutrophication, Chlorophyll a, Carbon dioxide, Organic carbon, Nutrients, Phytoplankton, Cell volume, Image analysis, Bacterial analysis, Temperature effects, Growth rates, Food chains.

During three periods of 16 to 25 days, bacterioplankton production, bacterial cell volume, chlorophyll a, CO2 assimilation, and particulate organic carbon were measured in enclosures situated in the eutrophic estuary Roskilde Fjord, Denmark. The enclosures were manipulated with respect to sediment contact and contents of inorganic nutrients, planktivorous fish, and suspension-feeding bivalves. Nutrient enrichment, the presence of suspension feeders, and sediment contact induced pronounced changes in bacterial production, as well as minor changes in bacterial cell volume; however, these effects seemed to be indirect, transmitted via phytoplankton. Bacterial production, measured as (3H)thymidine incorporation, closely followed changes in phytoplankton biomass and production, with time lags of 5 to 10 days. Good correlations of mean bacterioplankton production to chlorophyll a concentration and CO2 assimilation suggested phytoplankton to be the dominating source of bacterial substrate, apparently independent of nutrient stress. Zooplankton > 140 microm, bivalves, and sediment seemed to provide insignificant, if any, substrate for bacterioplankton, and benthic suspension feeders seemed not to act as direct competitors for dissolved organic carbon. The bacterioplankton mean cell volume, measured by image analysis, changed seasonally with the smallest cells during the summer. Within each period, the bacterial cell volume correlated positively to growth rate and negatively to temperature. (Author's abstract)
W89-12657

ECOLOGY OF VIBRIO CHOLERAE NON-O1 AND SALMONELLA SPP. AND ROLE OF ZOOPLANKTON IN THEIR SEASONAL DISTRIBUTION IN FUKUYAMA COASTAL WATERS, JAPAN.
Hiroshima Univ. (Japan). Faculty of Applied Biological Science.
For primary bibliographic entry see Field 5B.
W89-12661

PRIMARY PRODUCTION IN THE GERNIKA ESTUARY DURING A SUMMER BLOOM OF THE DINOFLAGELLATE PERIDINIUM QUINQUECORNE ABE.
Universidad del Pais Vasco, Bilbao (Spain). Lab. de Ecologia.
I. de Madariaga, E. Orive, and G. T. Boalch.
Botanica Marina BOTNA7, Vol. 32, No. 2, p 159-165, March 1989. 8 fig, 33 ref.

Descriptors: *Estuaries, *Primary productivity, *Phytoplankton, *Dinoflagellates, *Peridinium, Nutrients, Eutrophication, Biomass, Temperature, Light intensity, Temporal distribution, Seasonal variation, Population dynamics, Environmental gradient, Population density.

The major features of the temporal distribution of phytoplankton biomass and primary production in estuaries are predominantly a function of physical processes acting on different spatial and/or temporal scales. Size fractionated primary production and phytoplankton biomass related to hydrographical parameters were measured in the summer of 1987 in the Gernika estuary during a bloom of Peridinium quinquecorne Abe. Changes in river runoff, tidal amplitude and meteorological conditions determined short-term variations in nutrient levels, chlorophyll content, primary production and cell counts. The initiation of bloom conditions took place during neap tides, after a period of rain which provided the estuary with a considerable amount of nutrients, mainly nitrogen compounds and silicate. The phytoplankton community was dominated by the dinoflagellate P. quinquicorne which showed a marked spatio-temporal variability, being more abundant in the upper part of the estuary, where cell counts higher than 400,000 cells per liter were recorded. The fraction greater than 8 microm, containing all the p. quinquecorne, was responsible for most of the primary production during the study period. Phytoplankton abundance and production drastically decreased towards the mouth of the estuary where, by contrast, the assimilation index increased. At the end of the study period a marked decrease in solar radiation and water temperature could explain the sudden fall in dinoflagellate dominated primary production observed in the upper estuary. (White-Reimer-PTT)
W89-12669

STUDIES ON THE RECENTLY INTRODUCED BROWN ALGA SARGASSUM MUTICUM (YENDO) FENSHOLT: THE EFFECT OF TEMPERATURE, IRRADIANCE AND SALINITY ON GERMLING GROWTH.
Portsmouth Polytechnic (England). School of Biological Sciences.
J. M. Hales, and R. L. Fletcher.
Botanica Marina BOTNA7, Vol. 32, No. 2, p 167-176, March 1989. 3 fig, 1 tab, 58 ref. Dept. of the Environment contract DGR/483/36.

Descriptors: *Algal growth, *Marine algae, *Phaeophyta, *Introduced species, *England, Temperature, Irradiation, Salinity, Growth rates, Competition, Distribution.

The growth rates of germlings of the large, introduced, brown alga Sargassum muticum collected from Bembridge, Isle of Wight, south coast of England, are described under different conditions of temperature, irradiance and salinity. The germlings showed a broad tolerance to all three environmental parameters, with growth recorded from 10 to 30 C, 9 to 175 microE/sq m/s (500 to 10,000 lux), and 6.8 to 34 ppt salinity. Optimum growth occurred at 25 C, 44 microE/sq m/s, and 34 ppt salinity. The presence of attached S. muticum in the English Channel and in the Mediterranean suggests that it will also be able to colonize sheltered shores of intermediate temperature on the Atlantic coasts of France, Spain and Portugal. Other factors contributing to the success of S. muticum as a competitive immigrant species are the rapid growth rate of its young germlings and tolerance of high irradiance levels enabling occupation of intertidal rockpools and shallow lagoons. The depth to which S. muticum will be able to colonize any portion of coast will depend primarily upon turbidity and light quality as well as the nature of the substratum and biological competition. (White-Reimer-PTT)
W89-12670

BACTERIAL UPTAKE OF DISSOLVED FREE AND COMBINED AMINO ACIDS IN ESTUARINE WATER.
Delaware Univ., Lewes. Coll. of Marine Studies.
R. B. Coffin.
Limnology and Oceanography LIOCAH, Vol. 34, No. 3, p 531-542, May 1989. 10 fig, 1 tab, 51 ref. Office of Sea Grant (NA80AA D-00106 and NA83AA D-0017).

Descriptors: *Nutrients, *Aquatic bacteria, *Estuaries, *Amino acids, Delaware Bay, Bacterial substrates, Proteins, Spatial variation, Temporal variation, Absorption, Bacterial physiology.

The Delaware estuary was sampled at 10-14 stations along the main salinity axis from February to August 1985. Dissolved free and combined amino acid concentrations ranged from 50 nM to 1.4 microM and 0.1 to 8.0 microM, respectively. Combined amino acid concentrations were generally higher than dissolved free amino acids. Highest amino acid concentrations were measured in the lower estuary in early spring. Molecular weight analysis of the dissolved combined amino acids revealed that a high percentage of the pool contained peptides of $<1,000$ daltons. Uptake of 14C-labeled amino acids and an algal protein were used to estimate the relative importance of these potential bacterial substrates. Laboratory experiments verified that peptide and protein uptake was nonspecific and that labeled algal protein was a good model substrate. Combined and free amino acid uptake rates ranged spatially and temporally from 15 to 600 nM/h. Combined amino acid uptake averaged 51% of the bacterial amino nitrogen demand. (Author's abstract)
W89-12702

SEASONALITY OF NUTRIENT REGENERATION IN AN ORGANIC-RICH COASTAL SEDIMENT: KINETIC MODELING OF CHANGING PORE-WATER NUTRIENT AND SULFATE DISTRIBUTIONS.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
J. V. Klump, and C. S. Martens.
Limnology and Oceanography LIOCAH, Vol. 34, No. 3, p 559-577, May 1989. 12 fig, 2 tab, 51 ref. NSF grants OCE 80-09245 and OCE 82-08666.

Descriptors: *Cycling nutrients, *Interstitial water, *Coastal waters, *Marine sediments, *Organic matter, *Ammonium, *Phosphates, *Inorganic carbon, *Model studies, *Sulfates, Seasonal variation, Temperature, Time, Porosity, North Carolina, Water depth.

Measured pore-water concentration profiles for dissolved ammonium, phosphate, total inorganic carbon, and sulfate show a distinct seasonal cycle in response to the temperature dependence of rates of microbially mediated organic matter oxidation in sediments at Cape Lookout Bight, N.C. The depth and temperature dependence of measured production and consumption rates, adsorption coefficients, apparent diffusion coefficients, and sediment porosities were combined to construct a diagenetic model of ammonium production, CO2 production, and sulfate reduction that was time-, temperature-, and depth-dependent. Numerical predictions of pore-water profiles through summer and fall--the period of greatest change in reaction rates in response to seasonal fluctuations in temperature. Modeling also indicates that inclusion of complex, porosity-dependent terms, even in the time-dependent and temperature-dependent case, is probably unnecessary in these sediments; similar, constant-porosity models give results that generally deviate $<4\%$ from the predictions of complex models. (Author's abstract)
W89-12704

SULFATE REDUCTION AND OTHER SEDIMENTARY BIOGEOCHEMISTRY IN A NORTHERN NEW ENGLAND SALT MARSH.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
M. E. Hines, S. L. Knollmeyer, and J. B. Tugel.
Limnology and Oceanography LIOCAH, Vol. 34, No. 3, p 578-590, May 1989. 7 fig, 43 ref. NASA grant NAGW-512.

Descriptors: *Sediments, *Wetlands, *Sulfates, *Salt marshes, *Marsh plants, *Geochemistry, Marsh soils, New Hampshire, Iron, Sulfides, Alkalinity, Spartina, Seasonal variation, Tidal effects, Rainfall impact, Oxidation-reduction potential, Interstitial water.

Sulfate reduction rates, dissolved iron and sulfide concentrations, and titration alkalinity were measured in salt marsh soils along a transect that included areas inhabited by both the tall and short forms of Spartina alterniflora and by S. patens. Pore waters were collected with in situ 'sippers' to acquire temporal data from the same location without disturbing plant roots. During 1984, rates of SO4(2--) reduction increased fivefold (to >2.5 micromol/mL/d) when plants began elongating above ground yet decreased fourfold upon plant flowering. This rapid increase in rates of SO4(2--) reduction must have been fueled by dissolved organic matter released from roots only during active growth. Once plants flowered, the supply of oxidants to the soil decreased and sulfide and alkalinity concentrations increased despite decreases in SO4(2--) reduction and increases in SO4(2--):Cl(-) ratios. Sulfide concentrations were highest in soils inhabited by the tallest plants. During 1985, S. Alterniflora became infested with fly larvae (Chaetopsis apicalis John) and above ground growth ceases in late June. This cessation was accompanied by decreased rates of SO4(2--) reduction similar to those noted during the previous year when flowering occurred. After the fly infestation, the pore-water chemical profiles of these soils resembled profiles of soils inhabited by the short form of S. alterniflora. The SO4(2--) reduction rates in S. patens were similar to those in S. alterniflora except that they did not increase greatly when S. patens was elongating. Tidal and rainfall events produced desiccation-saturation cycles that altered redox conditions in the S. patens soils, resulting in rapid changes in the dissolution and precipitation of iron and in the magnitude and spatial distribution of SO4(2--) reduction. (Author's abstract)
W89-12705

EVALUATION OF PRODUCTION AND DEEUTROPHICATION MEANS AMONG CYSTOSEIRA POPULATIONS IN A SEA EUTROPHICATION ECOSYSTEM (OTSENKA PRODUKTSIONNYKH I DEEVTROFIKATSIONNYKH VOZMOZHNOSTEI POPULIATSII TSISTOZIRY V MORSKOI EVTROFIRMEMOI EKOSISTEME).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
For primary bibliographic entry see Field 5G.
W89-12717

OXYGEN EXCHANGE UNDER WATER-AIR CONDITIONS IN THE DNIEPER ESTUARY (OB OBMENE KISLORODOM NAGRANITSE RAZDELA 'VODA-ATMOSFERA' V USTEVOI OBLASTI DNEPRA).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
L. A. Zhurovleva, and V. N. Samoilenko.
Gidrobiologicheski Zhurnal GBZUAM, Vol. 24, No. 5, p 59-64, 1988. 2 fig, 2 tab, 14 ref. English summary.

Descriptors: *Air-water interfaces, *Dnieper Estuary, *Oxygen transfer, *Estuaries, Flood plains, Aquatic plants, Marshes, River mouth.

Meteorological conditions and biochemical processes occurring within the water body are the main factors determining the atmosphere-water body gas exchange in the Dnieper estuary region. Calculations of oxygen outflows in its different regions have shown that gas exchange with the atmosphere proceeds constantly but with various intensity during the day and during the whole vegetation period. The process of evasion is the most active in the flood plain pools of the Upper Dnieper. Oxygen uptake from the atmosphere is dominating for the Dnieper-Bug marsh area. The results show that gas exchange with the atmosphere is of essential importance in the oxygen balance of the Dnieper estuary pools. (Author's abstract)
W89-12724

TYPE CLASSIFICATION OF BRACKISH WATERS ON A HYDROBIOLOGICAL BASIS (TIPIZATSIIA SOLONOVATYKH VOD NA GIDROBIOLOGICHESKOI OSNOVE).
Khersonskaia Gidrobiologicheskaia Stantsiia (URSR).
T. G. Moroz, and V. L. Gilman.
Gidrobiologicheski Zhurnal GBZUAM, Vol. 24, No. 5, p 64-67, 1988. 12 ref. English summary.

Descriptors: *Estuaries, *Benthic fauna, *Dnieper Estuary, *Marshes, Hydrobiology, Chemical properties, Physical properties.

Regularities in the benthic fauna distribution were found to depend on the nature of the water bodies studied. Types of salty water masses in the Dnieper-Bug marsh area which affect the formation of the benthic biocenoses were identified with regard to physical, hydrological, hydrochemical and biological data. (Author's abstract)
W89-12725

DISSOLVED OXYGEN AND ITS RELATION TO THE NUTRIENTS IN CONCEPCION BAY DURING A PERIOD OF UPWELLING (OXIGENO DISUELTO Y SU RELACION CON LOS NUTRIENTES EN LA BAHIA DE CONCEPCION, DURANTE UN PERIODO DE SURGENCIA).
Pontificia Univ. Catolica de Chile, Talcahuano. Area de Biologia y Tecnologia del Mar.
R. Ahumada, A. Rudolph, and P. Matrai.
Investigaciones Marinas, Vol. 12, p 15-26, December 1984. 4 fig, 4 tab, 11 ref. (English summary).

Descriptors: *Bays, *Concepcion Bay, *Nutrients, *Dissolved oxygen, *Upwelling, Phosphates, Nitrates, Coastal waters.

An analysis of oxygen and nutrient data obtained from Concepcion Bay in October 1979, show a high correlation for the upwelling period. The correlation for values of oxygen/phosphate, oxygen/nitrate and nitrate/phosphate in coastal waters (both off and inside the bay) would suggest that all these correlations would have a biological source. The theoretical concentration values of phosphate and nitrate were obtained from AOU. These values were compared with the observed ones. The differences between the observed values and the theoretical ones are related with denitrification processes in the Concepcion Bay. (Author's abstract)
W89-12749

TRIBUTYLTIN IN BAY MUSSELS (MYTILUS EDULIS) OF THE PACIFIC COAST OF THE UNITED STATES.
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
For primary bibliographic entry see Field 5B.
W89-12758

EFFECT OF ESTUARY TYPE SUSPENDED SOLIDS ON SURVIVAL OF E. COLI IN SALINE WATERS.
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 5A.
W89-12787

DISTRIBUTION AND FRACTIONATION OF HEAVY METALS IN THE CAUVERY ESTUARY, INDIA.
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 5A.
W89-12856

ALGAL ASSAY OF RELATIVE ABUNDANCE OF PHYTOPLANKTON NUTRIENTS IN NORTHEAST UNITED STATES COASTAL AND SHELF WATERS.
National Marine Fisheries Service, Highlands, NJ. Sandy Hook Lab.
For primary bibliographic entry see Field 5B.
W89-12865

GROWTH AND PRODUCTION OF THE GREEN ALGA CLADOPHORA MONTAGNEANA IN A EUTROPHIC AUSTRALIAN ESTUARY AND ITS INTERPRETATION USING A COMPUTER PROGRAM.
Western Australia Univ., Nedlands. Dept. of Botany.
D. M. Gordon, and A. J. McComb.
Water Research WATRAG, Vol. 23, No. 5, p 633-645, May 1989. 6 fig, 5 tab, 37 ref.

Descriptors: *Eutrophication, *Chlorophyta, *Estuaries, *Australia, *Computer models, Photosynthesis, Nutrients, Water temperature, Growth rates, Algal growth, Light penetration, Light intensity, Computer programs.

The shallow, eutrophic Peel-Harvey estuary developed massive populations of a green alga, Cladophora montagneana, forming extensive free-living mats on its floor. Growth rates of confined populations were measured in the field for 2 successive years. Experimentally-derived relationships describing growth and photosynthesis as a function of light, temperature and inorganic nutrients were used to develop a computer program to interpret the performance of this alga in the field. Growth was strongly seasonal, with a maximum in summer (up to 1.3%/day), and ceased in winter. Net production in the mat was low, up to 3.4 g (dry weight)/sq m/day, with only the surface layer photosynthetically active because of self-shading. Similar seasonal trends, but faster growth rates (maximum 2.7%/day) were obtained with algae transferred to shallower waters in Peel Inlet, where light intensity was greater. Cladophora transferred from Peel Inlet to Harvey Estuary grew little or not at all, consistent with its absence in this part of the estuary. Computer simulations of growth using real environmental data emphasize the importance of light, and self-shading in particular, in controlling productivity. (Author's abstract)
W89-12868

VERTICAL DISTRIBUTION OF PHYTOPLANKTON IN A STRATIFIED ESTUARY.
Biological Inst., Dubrovnik (Yugoslavia).
D. Vilicic, T. Legovic, and V. Zutic.
Aquatic Sciences, Vol. 51, No. 1, p 31-46, 1989. 3 fig, 5 tab, 38 ref.

Descriptors: *Estuaries, *Phytoplankton, *Stratification, Krka Estuary, Adriatic Sea, Organic carbon, Particulate matter, Chlorophyll, Algae, Brackish water, Marine algae, Saline-freshwater interfaces, Interfaces.

The vertical distribution of physicochemical parameters and phytoplankton density around the halocline in the Krka estuary, Adriatic Sea, was investigated in November 1984 (low river discharge of 31.5 cu m/sec) and in April 1985 (high river discharge of 83.5 cu m/sec). The 25 km estuary has a low sediment load, considerable freshwater discharge, low tides, and stratified flow. In April the freshwater/seawater interface was at 3 to 3.5 m with a high salinity gradient. In November the interface layer was at 1.8 to 2 m, with the upper layer partially mixed with saline water. Suspended matter, surfactant activity, surface active aggregates, particulate organic carbon and phaeophytin all showed highest concentrations in the 20-50 cm thick interface layer. The highest concentration of chlorophyll a, found on the upper boundary of the interface, was attributed to the accumulation of viable freshwater phytoplankton. The larger size fractions accumulated faster than the smaller ones, that is, the nanoplankton were least abundant. The interface was also the site of phytoplankton decomposition, as shown by the small ratio of chlorophyll a to phaeophytin. Marine flagellates migrated to the interface and reproduced there; some species such as Prorocentrum micans and Syracosphere were also found in the upper freshwater layer. (Cassar-PTT)
W89-12923

INTRACELLULAR SOLUTES, PHOTOSYNTHESIS AND RESPIRATION OF THE GREEN ALGAE BLIDINGIA MINIMA IN RESPONSE TO SALINITY STRESS.
Bremen Univ. (Germany, F.R.). Fachbereich Chemie/Biologie.
U. Karsten, and G. O. Kirst.
Botanica Acta, Vol. 102, No. 2, p 123-128, May 1989. 7 fig, 40 ref.

Descriptors: *Salt tolerance, *Estuaries, *Saline water, *Algae, *Photosynthesis, Stress, Respiration, Blidingia, Osmotic pressure, Marine algae, Potassium, Sodium, Chlorides, Phosphates, Nitrates, Magnesium, Sulfur compounds.

The effects of salinity (7 to 68 ppt) on the internal inorganic nd organic solute concentrations, and on the photosynthesis and respiration were investigated in the green algae Blidingia minima (Nag. ex Kutz.) Kylin. The levels of the main osmotic solutes potassium ion, sucrose and proline increased with increasing salinities and vice versa, while sodium ion, magnesium ion, chloride and phosphate played a minor role in the osmotic acclimation. B. minima showed high nitrate concentrations, which decreased under hyposaline and hypersaline conditions. B. minima also accumulated beta-dimethylsulfoniopropionate in osmotically significant amounts under gently hypersaline conditions. The alga showed characteristics typical of sun plant, having a high light compensation point and a saturation of photosynthesis at high photon flux densities. Under osmotic stress, the alga showed a broad photosynthetic stability, but under hypersaline conditions photosynthesis was partly inhibited. The respiration rate remained constant in hypersaline media, and was stimulated under hyposaline conditions. (Cassar-PTT)
W89-12926

VARIATION IN LEAF ULTRASTRUCTURE OF RUPPIA MARITIMA L. ALONG A SALINITY GRADIENT.
Maine Univ. at Orono. Dept. of Forest Biology.
R. Jagels, and A. Barnabas.
Aquatic Botany AQBODS, Vol. 33, No. 3-4, p 207-221, June 1989. 15 fig, 2 tab, 45 ref.

Descriptors: *Estuaries, *Sea grasses, *Aquatic plants, *Plant physiology, *Salt tolerance, Halophytes, Ruppia maritima, Salt marshes, Marshes, Saline water, Osmotic pressure, Plant growth, Leaves, Plant tissues.

Distinct differences in leaf ultrastructure were found in Ruppia maritima L. growing in waters of low vs. high salinities. Leaf epidermal cells of low-salinity plants, compared with those of high-salinity plants, were characterized by larger central vacuoles; fewer chloroplasts; reduced plasmalemma area (owing to less extensive plasmalemma invaginations); fewer mitochondria; thinner walls; reduced extracytoplasmic volume; symplastic connections with mesophyll cells (which are absent in high-salinity plants). Histochemically, cell walls of high-salinity plants showed a stronger acidity gradient based on staining for sulfated and acid mucopolychaccharides. (Author's abstract)
W89-12930

PREDICTION MODEL FOR STATIONARY, SHORT-CRESTED WAVES IN SHALLOW WATER WITH AMBIENT CURRENTS.
Technische Hogeschool Delft (Netherlands).
L. H. Holthuijsen, N. Booij, and T. H. C. Herbers.
Coastal Engineering COENDE, Vol. 13, No. 1, p 23-54, May 1989. 8 fig, 1 tab, 51 ref.

Descriptors: *Limnology, *Estuaries, *Waves, *Shallow water, Model studies, HISWA model, Wave propagation, Wind waves, Rhine Estuary, Coastal engineering, Forecasting, Mathematical models, Wave crest.

A numerical model for the hindcasting of waves in shallow water (HISWA) was tested in a closed branch of the Rhine Estuary where measurements with buoys and a wave gauge were available. Wave breaking and short-crestedness dominated in this area, resulting in rms errors in the significant wave height and mean wave period of about 10 and 13%, respectively, of observed values. The model was based on a Eulerian presentation of the spectral action balance of the waves rather than on the more conventional Lagrangian presentation. Wave propagation was computed on a grid rather than along rays. The model accounted for refractive propagation of short-crested waves over arbitrary bottom topography and current fields. The effects of wave growth and dissipation due to wind generation, bottom dissipation, and wavebreaking (in deep and shallow water) were represented as source terms in the action balance equation. The computational efficiency of the model was enhanced by simplification of the basic balance equation: (1) the removal of time as an independent variable to obtain a stationary model and (2) the parameterization of the basic balance equation in terms of a mean frequency and a frequency-integrated action density, both as function of the spectral wave direction. (Cassar-PTT)
W89-12933

ACTIVE MANAGEMENT OF AN ARTIFICIAL ROCKY COAST.
Ministry of Transport and Public Works, The Hague (Netherlands). Tidal Waters Div.
R. J. Leewis, H. W. Waardenburg, and A. J. M. Meijer.
Hydrobiological Bulletin HYBUD9, Vol. 23, No. 1, p 91-99, March 1989. 3 fig, 3 tab, 37 ref.

Descriptors: *Estuaries, *Dikes, *Coastal engineering, *Rock fill, Water quality, The Netherlands, Shores, Marine animals, Marine algae, Aquatic plants, Marine plants, Shellfish, Reefs, Ecosystems, Bioaccumulation, Water treatment, Biological treatment, Shore protection.

The flora and fauna populating the dikes on the Netherlands coast depend on many factors, including tidal amplitude, water quality, available light, and food sources. Several properties of the dike substrate also affect the growth of organisms. Species diversity is less on smooth stones, rectangular stones, nonporous stones, and dark stones. Although larger stones usually have greater species diversity, a loose arrangement of small stones can also provide habitats of great diversity. With respect to chemical composition of the substrate, concrete is a good substrate for the growth of many organisms; limestone, and manganese and steel slags also permit good growth. Least suitable substrates are asphalt-covered materials, copper slag, mine stone, and basalt. Recommendations for management of artificial substrates in the intertidal and subtidal zones are as follows: (1) determine the potential adverse effects of any natural or artificial materials, (2) avoid use of asphalt, (3) use stones of large water retention capacity, (4) use elements of

a size greater than 30 cm, (5) place the elements loosely, and (6) develop a concrete block shape which provides maximal habitat conditions as well as good technical properties and easy handling. Possible uses of marine organisms to help preserve the artificial shore structures include mussel culture and laminaria cultures on rafts at threatened shore areas. Marine organisms can also function as water purification agents in areas of wastewater discharge. For example, algae can remove nitrates and phosphates from the water; sponges can reduce bacteria and fungi counts. When no growth of marine life is desirable, such as at inlets and outlets of power stations, in sluices, and on moving structures, anti-fouling paints or biological controls can be used. (Cassar-PTT)
W89-12945

SPATIO-TEMPORAL VARIATIONS OF SIZE-FRACTIONATED PRIMARY PRODUCTION IN THE GERNIKA ESTUARY.
Universidad del Pais Vasco, Bilbao (Spain). Lab. de Ecologia.
I. de Madariaga, and E. Orive.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 127, No. 3, p 273-288, July 17, 1989. 7 fig, 4 tab, 37 ref.

Descriptors: *Estuaries, *Primary productivity, *Phytoplankton, *Particle size, Seasonal variation, Algae, Productivity, Gernika Estuary, Spain, Spatial distribution, Temporal distribution, Biomass, Dinoflagellates, Peridinium quinquecorne, Irradiance.

Size-fractionated primary production was measured daily during four 6-7 day periods over an annual cycle at three permanent sites within the Gernika Estuary. Both primary production and chlorophyll a followed a clear seasonal pattern of variation at all sites. The highest short-term variability was found in summer when favorable environmental conditions made possible the development of a dense bloom of the dinoflagellate Peridinium quinquecorne Abe at the middle and upper estuary. In contrast, during the subsequent surveys, lower values of phytoplankton production and biomass were measured, and these variations were associated with changes in freshwater runoff and irradiance levels. Most of the spatio-temporal variability in primary production within this estuary can be explained by variations in phytoplankton biomass and light availability. The >8-micrometer class was normally the most productive fraction, and its contribution to the total primary production averaged 69.4%. The 3 to 8-micrometer fraction typically accounted for 21.1% of the total primary production, and the 0.2 to 3-micrometer fraction for 9.4%. The relative contribution of the smaller phytoplankton classes to the total primary production increased when illumination levels went down, i.e., coinciding with rain pulses and depth in the water column. These results suggest that small nanoplankton and picoplankton could be more efficient at using light intensities for photosynthesis within this estuary than the larger phytoplankton. (Author's abstract)
W89-12947

ECOLOGICAL STUDIES ON THE PHYTOPLANKTON OF BOKNAFJORDEN, WESTERN NORWAY. II. ENVIRONMENTAL CONTROL OF PHOTOSYNTHESIS.
Norsk Inst. for Vannforskning, Oslo.
S. R. Erga.
Journal of Plankton Research JPLRD9, Vol. 11, No. 4, p 785-812, July 1989. 14 fig, 4 tab, 132 ref.

Descriptors: *Estuaries, *Fjords, *Phytoplankton, *Photosynthesis, Boknafjorden, Norway, Primary productivity, Productivity, Growth rates, Euphotic zone, Seasonal variation, Light penetration, Temperature, Water temperature, Zooplankton.

Both predicted (incubator) and measured (in situ) C14-assimilation rates were studied from February to November 1981 at three stations in Boknafjorden, a deep silled fjord of western Norway. Samples were taken from different light depths within the euphotic zone. A high degree of conformity was found between the two approaches. Daily values of carbon assimilation integrated over the euphotic zone varied between 0.05 and 1.4 g C/sq m. Yearly primary production varied between stations from 82 to 112 g C/sq m (120-138 g C/sq m based on average light conditions). The light-saturation curve parameters were as follows: initial slope of the light-saturation curve, 0.0056 to 0.0537 mg C per mg chlorophyll a per hour per microE sq m; photosynthetic capacity, 0.7 to 8.5 mg C per mg chlorophyll a per hour (in situ assimilation numbers ranged from 0.9 to 9.3 mg C per mg chlorophyll a per hour). These compare well with data for the northwestern side of the Atlantic. The overall importance of light in controlling photosynthesis throughout the year was revealed by the light utilization index, estimated to be 0.43 mg C per mg chlorophyll a per E sq m. The maximum quantum yield was found on August 17, with 0.089 mol C per E. Chlorophyll a to carbon ratios above and below 0.010 were found for shade-and light-adapted cells, respectively. Assimilation numbers and growth rates were linearly related only when considering light-adapted cells. Maximum growth rates were measured during an autumn bloom of the dinoflagellate Gyrodinium aureolum (1.0 doubling per day), while 0.7 to 0.8 doubling per day were found for a winter bloom (water temperature, 2 C) of the diatom Skeletonema costatum. No unambiguous temperature effect on assimilation number and growth of phytoplankton was recognized in the fjord. There was a tendency toward increased assimilation numbers with increased water column stability. The highest photosynthetic capacity values were often encountered at almost undetectable nutrient concentrations. This was attributed to recycling of nutrients by zooplankton. (Cassar-PTT)
W89-12961

POTENTIAL THEORY-BASED FINITE ELEMENT ALGORITHM FOR FRESHWATER RECHARGE OF SALINE AQUIFERS: A SHARP INTERFACE MODEL.
Haryana Agricultural Univ., Hissar (India). Dept. of Soils.
For primary bibliographic entry see Field 2F.
W89-12994

BOUNDARY AND INTERFACE CONDITIONS IN POROUS MEDIA.
CyberLink Corp., Boulder, CO.
For primary bibliographic entry see Field 2F.
W89-12996

OXYGEN CONSUMPTION, NEW PRODUCTION, VERTICAL ADVECTION AND ENVIRONMENTAL EVOLUTION IN THE MEDITERRANEAN SEA.
Paris-6 Univ. (France). Lab. de Physique et Chimie Mariens.
For primary bibliographic entry see Field 5C.
W89-13007

SIMPLIFIED METHOD FOR WETLAND HABITAT ASSESSMENT.
Kansas State Univ., Manhattan. Dept. of Forestry.
For primary bibliographic entry see Field 2H.
W89-13014

PRELIMINARY STUDY OF ANAEROBIC THIOSULFATE-OXIDIZING BACTERIA AS DENITRIFIERS IN THE ARABIAN SEA.
National Inst. of Oceanography, Panaji (India).
P. A. Loka Bharathi, D. Chadramohan, and S. Nair.
Geomicrobiology Journal GEJODG, Vol. 6, No. 3/4, p 195-207, 1988. 4 fig, 7 tab, 33 ref.

Descriptors: *Marine bacteria, *Denitrification, *Thiosulfates, *Nitrates, *Arabian Sea, *Iron bacteria, *Sulfur bacteria, Nitrogen removal, Coastal waters, Bacteria.

Bacteria which oxidize thiosulfate and reduce nitrate (TONRB) and bacteria which oxidize thiosulfate and denitrify (TODB) sampled at 5-m, 100-m, 200-m and 300-m depths were enumerated in agar shake cultures by colony counting and by applying MPN (most probable number) technique, respectively. Lithotropic denitrification was generally high at the surface but did not vary much with the distance from shore as indicated by the number of TODB. The number of TONRB shows that nitrate reduction was much higher at near-shore stations. The low TODB/TONRB ratios at intermediate depths and at 100 m show in particular that the relative abundance of these organisms could be one of the possible reasons for higher nitrate concentrations sometimes reported at these depths. Thiosulfate-oxidizing and simultaneous nitrate-reducing abilities of the isolates indicated that the strains isolated from near shore and surface waters were more active nitrate reducers than their counterparts in offshore or deeper waters. The growth yield values of these organisms ranged from 1.1-17.9 mg protein/mmol thiosulfate and from 11.7-36.3 mg protein/mmol sulfide and suggest that they could contribute to chemosynthetic production. (Author's abstract)
W89-13031

LOW FREQUENCY VARIABILITY IN THE LOWER ST. LAWRENCE ESTUARY.
Quebec Univ., Rimouski. Dept. of Oceanography.
G. Mertz, M. I. El-Sabh, and V. G. Koutitonsky.
Journal of Marine Research JMMRAO, Vol. 47, No. 2, p 285-302, May 1989. 11 fig, 1 tab, 34 ref. Ministry of Supply and Services Canada contract ISD-78-00066.

Descriptors: *Estuaries, *Water currents, *Remote sensing, *Current meters, *St Lawrence Estuary, Satellite technology, Gages.

The lower St. Lawrence Estuary is a good example of wide estuaries with a second lateral boundary within several internal Rossby radii. Direct measurements from the 1979 lower St. Lawrence estuary mesoscale current meter array were compared with satellite thermal images observed during the same period. The current field appears to show two quasi-steady states: one configuration is characterized by strong outflow along the north shore of the estuary with a transverse front at the mouth. The other current pattern is more typical of estuaries, with inflow along the north shore and outflow along the south shore. Transitions between these configurations are likely to be due to instability of the current field. (Author's abstract)
W89-13036

VARIABILITY OF THE COASTAL CURRENT AND NUTRIENT PATHWAYS IN THE EASTERN GULF OF MAINE.
Texas A and M Univ., College Station. Dept. of Oceanography.
D. A. Brooks, and D. W. Townsend.
Journal of Marine Research JMMRAO, Vol. 47, No. 2, p 303-321, May 1989. 9 fig, 13 ref. NSF Grants OCE85-11281, OCE86-14187, and OCE84-08779.

Descriptors: *Coastal waters, *Water currents, *Nutrients, *Gulf of Maine.

The eastern Maine coastal current flows southwestward, carrying cold and nutrient-rich waters along the coast from the tidally stirred eastern gulf toward the central and western gulf, where in summer the waters are warmer and more stratified. The current typically turns offshore before reaching Penobscot Bay, near the central coast, at a location determined largely by the distribution of dense slope water in Jordan Basin. The slope water, which enters the gulf as a deep inflow from the Atlantic Ocean, thus plays a major role in determining the intensity, direction and timing of the delivery of nutrients to the interior gulf. Data from two cruises in August 1987 were used to examine the variability and nutrient transport of the coastal currents, especially to show the important physical linkages between the deep slope water, the structure of the coastal current, and its likely significant effect on biological productivity in the gulf. Upwelling induced by the divergence of the coastal current as it separates from the coast may be an important mechanism for bringing nutrients into the surface waters along the eastern

Maine coast. The biological impact of the redirected coastal current may be significant because the current carries nutrients and phytoplankton from the tidally mixed eastern gulf into the central gulf surface waters. The slope-water steering mechanism depends on the annual cycle of slope water influx and spreading, which is influenced by seasonal surface heating and cooling, river run-off, winds, and Gulf Stream rings. (Sand-PTT)
W89-13037

SILVER CONTAMINATION IN THE MARINE POLYCHAETE ANNELID SABELLA PAVONINA S.: A CYTOLOGICAL AND ANALYTIC STUDY.
Paris-6 Univ. (France). Lab. d'Histologie et de Cytologie des Invertebres Marins.
For primary bibliographic entry see Field 5B.
W89-13040

ENVIRO-ECONOMIC ASPECTS OF NAVIGATION CHANNEL DEVELOPMENT IN COASTAL LOUISIANA: A CASE STUDY.
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
For primary bibliographic entry see Field 6G.
W89-13049

EXPERIMENTAL STUDIES ON BIOLOGICAL AND CHEMICAL OXIDATION OF DISPERSED OIL IN SEAWATER.
Kuwait Inst. for Scientific Research, Safat. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W89-13061

UNIFIED METHOD OF ESTIMATING LONGITUDINAL DISPERSION IN ESTUARIES.
California Univ., Richmond. Sanitary Engineering and Environmental Health Research Lab.
For primary bibliographic entry see Field 5B.
W89-13074

HEAVY METAL CONTAMINATION OF A GREENLAND FJORD SYSTEM BY MINE WASTES.
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans.
For primary bibliographic entry see Field 5B.
W89-13115

SAND TRANSPORT IN TEXAS TIDAL INLET.
For primary bibliographic entry see Field 2J.
W89-13120

TIDAL SPECTROSCOPY OF A COASTAL AREA: OBSERVED AND SIMULATED TIDES OF THE LAKE MARACAIBO SYSTEM.
Universidad del Zulia, Maracaibo (Venezuela).
J. M. Molines, M. Fornerino, and C. Le Provost.
Continental Shelf Research CSHRDZ, Vol. 9, No. 4, p 301-323, April 1989. 12 fig, 5 tab, 18 ref.

Descriptors: *Tidal hydraulics, *Tidal currents, *Lake Maracaibo, *Coastal waters, Diurnal distribution, Tidal amplitude, Mathematical analysis, Model studies, Caribbean Sea, Venezuela, Comparison studies, Simulation.

Tide gauge data for the Lake Maracaibo system, a region of the Caribbean where tidal dynamics are the most important factor of the circulation, were analyzed. Local resonance for semidiurnal constituents and strong meteorological effects at S1 and S2 frequencies were clearly identified from the admittance curves. Different methods of finite difference modelling these tidal constituents were compared based on the bottom friction parameters. The simulation of each constituent alone with quadratic bottom friction gave good results only for the M2 wave (the dominant wave) which indicates that the secondary constituents cannot be simulated without taking into account the M2 wave. The simulation of the secondary constituents with a quasi-linearized bottom friction taking into account the M2 wave gave good results for both diurnal and semidiurnal constituents in different areas. Large duration simulation was also performed in order to reproduce the whole tidal spectrum together. This simulation gave similar results to the one for the semidiurnal and the diurnal astronomical constituents, and, in addition, nonlinear constituents such as 2MN2 were obtained. From these comparisons it was concluded that the technique of quasi-linearization of the bottom friction gives good results and is recommended instead of large duration simulation when the non-linear compound constituents can be ignored. Sea-level variations were predicted from the simulated harmonic constituents and compared with observations. Velocity fields were also predicted and qualitatively compared with available field measurements, showing a good agreement. (Author's abstact)
W89-13186

ZOOPLANKTON COMMUNITY STRUCTURE AND COPEPOD SPECIES COMPOSITION IN THE NORTHERN GULF OF MEXICO.
Atlantic Oceanographic and Meteorological Labs., Miami, FL.
For primary bibliographic entry see Field 2H.
W89-13187

TIDAL POWER AND THE AQUATIC ENVIRONMENT (ENERGIE MAREMOTRICE ET ENVIRONNEMENT AQUATIQUE).
Museume National d'Histoire Naturelle, Dinard (France). Lab. Maritime.
For primary bibliographic entry see Field 6G.
W89-13191

WATER QUALITY 88: SEMINAR PROCEEDINGS.
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 5G.
W89-13231

USE OF DAPHNIA MAGNA AND MYSIDOPSIS ALMYRA TO ASSESS SEDIMENT TOXICITY.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5A.
W89-13258

THIN-LAYER DISPOSAL: A MODIFICATION OF CONVENTIONAL OVERBOARD DISPOSAL OF DREDGED MATERIAL.
Corps of Engineers, Mobile, AL. Coastal Environment Section.
For primary bibliographic entry see Field 5E.
W89-13266

EVOLUTION OF THE THESSALONIKI-GIANNITSA PLAIN IN NORTHERN GREECE DURING THE LAST 2500 YEARS--FROM THE ALEXANDER THE GREAT ERA UNTIL TODAY.
Thessaloniki Univ., Salonika (Greece). Dept. of Geology and Physical Geography.
For primary bibliographic entry see Field 2H.
W89-13305

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

WATER AND WASTEWATER TREATMENT FOR A SMALL ISLAND RESORT.
Queensland Inst. of Tech., Brisbane (Australia). School of Civil Engineering.
B. Rigden.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 189-193, 1989. 1 tab, 2 ref.

Descriptors: *Water treatment facilities, *Wastewater facilities, *Biological wastewater treatment, *Desalination, *Reverse osmosis, Recreation, Tourism, Lady Elliot Island, Great Barrier Reef, Australia, Wastewater disposal, Secondary wastewater.

The design of a reverse osmosis desalination unit and a rotating biological contactor for water and wastewater treatment for Lady Elliot Island, a small island resort of about 100 tourists on the Great Barrier Reef, is described. Limited monitoring of the operation indicated the following: A design figure for water consumption of 200 L per capita per day appears conservative for this type of resort. A design feature for per capita BOD load for wastewater treatment should be at least 75 g per capita per day; the commonly used domestic wastewater figure of 55 appears inadequate. Rotating biological contactor systems appear to operate well under fluctuating load conditions and to produce consistently satisfactory effluent. The operators of the plant have found it simple to operate and maintain. Discharge of a reasonable standard secondary treated effluent into coarse sands appears to cause no aesthetic problems for visitors and no short-term adverse effects on the reef. Continued monitoring is recommended. (Sand-PTT)
W89-12228

SURFACE PROPERTIES IN MEMBRANE FILTRATION.
KSE, Inc., Amherst, MA.
R. Singh.
Chemical Engineering Progress CEPRA8, Vol. 85, No. 5/6. p 59-64, 1989. 6 fig, 2 tab, 15 ref.

Descriptors: *Membrane processes, *Membrane filters, *Filtration, *Cellulose acetate membranes, Reverse osmosis, Surface properties, Polymers, Desalination, Fouling, Ultrafiltration, Salt rejection.

Surface properties (including surface morphology, surface polarization, surface flow, and surface regeneration) of membrane filters are discussed in terms of reverse osmosis. Surface properties are of critical importance in establishing the performance of membranes because solute rejection and the rate of permeation of solvent or flux depend upon the size of the membrane and the chemical nature (dispersive, polar, ionic, etc) of both the permeant and the polymeric membrane material. Membranes have made major advances since the discovery of the asymetric cellulose acetate reverse osmosis membrane by Sourirajan and Loeb (S-L). New interfacially polymerized thin-film composite membrane (Film-Tec, FT-30) outperforms the S-L membrane by a factor of two in water flux while maintaining high salt rejection under single-pass sea water desalination conditions. Membrane fouling problems in reverse osmosis have been largely solved by site-specific (water chemistry) feed water pretreatment systems. Original estimates regarding the size of the ultrafiltration market have not materialized because of persistent and inherent problems of surface fouling. Growing recognition of the importance of colloidal and surface phenomena in membrane fouling has resulted in modifying membranes for specific applications. (Miller-PTT)
W89-12745

FUTURE FOR DESALINATION BY REVERSE OSMOSIS.
Kuwait Inst. for Scientific Research, Safat.
M. A. Jawad.
Desalination DSLNAH, Vol. 72, No. 1/2, p 23-28, Apr/May 1989. 2 fig, 2 tab, 6 ref.

Descriptors: *Seawater, *Brackish water, *Desalination, *Reverse osmosis, Pretreatment of water, Feedwater treatment, Semipermeable membranes, Water quality standards, Research priorities, Future planning.

Great advances have been made in seawater reverse osmosis technology during the last decade, which have led to a rapid increase in the use of this process. The application of reverse osmosis for desalting brackish water is established; however, for desalting seawater it is still in the optimization

stage. The main steps of this technology are (1) feed water pretreatment, (2) desalination by water passage through semipermeable membranes, and (3) post-treatment to meet quality standards. The two main interrelated areas of uncertainty which require attention are the extent of the membrane development and the pretreatment of the feed water. It is necessary to simplify this interrelation in order to positively influence the future of seawater desalination by reverse osmosis technology. (Fish-PTT)
W89-13139

HANDBOOK OF WATER PURIFICATION.
For primary bibliographic entry see Field 5F.
W89-13208

REVERSE OSMOSIS.
For primary bibliographic entry see Field 5F.
W89-13217

ELECTRODIALYSIS.
University Coll., London (England).
For primary bibliographic entry see Field 5F.
W89-13219

FRESHWATER DISTILLATION.
For primary bibliographic entry see Field 5F.
W89-13220

SALINE DISTILLATION.
For primary bibliographic entry see Field 5F.
W89-13221

LIFETIME STUDIES AND OPTIMIZATION FOR AFT-TREATED ELECTRODIALYSIS MEMBRANES.
Georgia Inst. of Tech., Atlanta. Energy and Material Sciences Lab.
For primary bibliographic entry see Field 5D.
W89-13356

WATER PURIFICATION AND WASTE CONCENTRATION BY THE VACUUM FREEZING MULTIPLE PHASE TRANSFORMATION PROCESS AND ITS EUTECTIC EXTENSION.
Calyxes Research and Development Corp., Albuquerque, NM.
C.-Y. Cheng, and W.-C. Cheng.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-220891/AS. Price codes: A05 in paper copy, A01 in microfiche. Final Report, (1988). 87p, 35 fig, 3 tab, 2 append. USGS Contract no. 14-08-0001-G1301.

Descriptors: *Water treatment, *Freezing, *Water reuse, *Vacuum freezing, *Vapor liquefaction, Water pollution treatment, Slurry pumping, Desalination, Eutectic freezing.

This study is a continuation of the study of the Volume Freezing Multiple Phase Transformation (VFMPT) process for desalination and water reuse. During the first grant period, bench scale experiments were completed for the VFMPT Process and initial design of a prototype VFMPT plant was completed. During the coarse of the second grant, the vacuum freezing and vapor liquefaction operations were tested in a prototype unit referred to as the '40 Inch Long' unit with freezing rates determined. The two step vapor liquefaction operation consisting of vapor desublimation and desublimate melting was conducted continuously using multiple condensers operating in sequence. Several designs were tested for circulating feed liquid to create surface area for evaporative freezing to take place. It was concluded that two rotating screws half submerged in the pool would be a very energy efficient method for providing the necessary surface area. Feeding of slurry from the vacuum freezer to the slurry, pump and slurry pumping from vacuum to ambient pressure for crystal washing were also successfully demonstrated using a disc-flow pump. The pumping of slurry from vacuum to ambient pressure allows for crystal washing and melting to take place at ambient pressure. Afterwards it was discovered that a rotating lobe pump could accomplish slurry pumping with much less energy input than the disc-flow pump required. A flowsheet was developed for the VFMPT plant with detailed mass and energy balances and energy requirements determined. (USGS)
W89-13383

3B. Water Yield Improvement

WATER HARVESTING SYSTEMS IN ARID LANDS.
Arizona Univ., Tucson. Coll. of Engineering.
C. B. Ciuff.
Desalination DSLNAH, Vol. 72, No. 1/2, p 149-159, Apr/May 1989. 3 fig, 14 ref.

Descriptors: *Water harvesting, *Water resources development, *Runoff, *Agricultural watersheds, *Arid-zone hydrology, Catchment areas, Rainfall, Computer models, Agricultural hydrology, Reservoir evaporation, Storage reservoirs, Pumping, Drainage engineering, Evaporation control, Calibrations.

The use of water harvesting systems in arid lands offers the potential of making lands productive that are now largely unusable due to lack of water for domestic livestock or agricultural use. The water harvesting system consists of a rainfall catchment and a storage facility. The use of compartmented reservoirs with small surface areas decreases evaporation, and, when combined with the collection of runoff from a natural or treated surface, makes it practical to provide water for supplemental irrigation (a water harvesting agrisystem). Concentration of water in a compartmented reservoir can be accomplished in flat terrain using a pump. Evaporation control can be improved with an evaporation control barrier. A computer model has been developed to help in the design of the water harvesting systems, including agrisystems with compartmented reservoirs. This program fits on portable personal computers and can thus be taken to a field location to develop an optimum design at a minimum cost. The model can be improved through calibration in a given area as systems are installed and data collected. (Author's abstract)
W89-13146

ENVIRONMENTAL POLICIES AT THE NATIONAL AND REGIONAL LEVELS: THE ROLE OF EPC, GCC AND ROPME.
Ministry of Public Health, Safat (Kuwait). Environment Protection Dept.
For primary bibliographic entry see Field 6E.
W89-13152

3C. Use Of Water Of Impaired Quality

ECONOMIC EFFECTS OF SALINITY AND DRAINAGE PROBLEMS.
Rhode Island Univ., Kingston. Dept. of Resource Economics.
D. Wichelns, R. E. Howitt, G. L. Horner, and D. Nelson.
California Agriculture CAGRA3, Vol. 42, No. 1, p 10-13, January-February 1988. 1 fig, 4 tab.

Descriptors: *Water reuse, *Salinity, *Drainage, *Crop production, *Costs, Agriculture, Crop yield, Economic aspects, Water districts, Fresno County, CA, Irrigation, Water quality, Tomatoes, Alfalfa, Barley, Wheat, Beets, Water table, Leaching, Drainage water.

Some of the costs associated with crop yield losses due to salinity and high water tables were estimated by collecting farm-level, time-series data on yields and cropping patterns in a small water district on the west side of California's San Joaquin Valley. Increases in average crop yields in the four years after installation of a drainage outlet in the Broadview Water District provide compelling evidence of crop responsiveness to improvements in drainage conditions. Average yields of the six crops examined exceeded county averages during those years. Yields of salt-sensitive tomatoes and alfalfa seed responded by 80% and 56%, respectively. Average yields of salt-tolerant barley, wheat, and sugarbeets also improved in Broadview, at a rate exceeding Fresno County yield increases, during the most recent period. This finding suggests that even crops considered to be tolerant of soil salinity may be adversely affected by continuous recycling of all drain water over a prolonged period. Yields of these crops responded positively to improvements in the quality of irrigation water and reductions in soil salinity made possible by improving the drainage situation in Broadview. It is concluded that leaching and recycling are temporary solutions to salinity problems. An outlet for collected drain water is required to maintain productivity in the long run. (Doria-PTT)
W89-12420

ESTIMATING SALINE WATER TABLE CONTRIBUTIONS TO CROP WATER USE.
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. E. Grismer, and T. K. Gates.
California Agriculture CAGRA3, Vol. 42, No. 2, p 23-24, March-April 1988. 1 fig, 2 tab.

Descriptors: *Water table, *Saline water, *Agriculture, *Irrigation design, *California, Drainage, Model studies, Evapotranspiration, Salinity, Toxicity, Soil types, Cotton, Semiarid lands.

Under arid conditions, water tables can supply as much as 60 to 70% of a crop's water requirement. Successful incorporation of the effects of saline high water tables on crop growth and drainage system performance into the design of irrigation-drainage systems and into performance models requires determination of the effect of water table depth and salinity on the percentage of crop water demand satisfied by the water table. A study was conducted to define such a relationship and determine how it might be applied in California. A simple equation was devised to predict water table contributions to crop water use for cotton grown in semi-arid regions such as the San Joaquin Valley. As more information becomes available, similar predictive equations could also be developed for sugarbeets, alfalfa, and other crops. In all cases, however, considerable experimental work in the field is necessary to refine these equations. Long-term effects of salinization of the root zone due to upward flow from the water table may also need to be considered. Development of predictive equations makes it possible for planners to incorporate interactions between the water table and root zone into design of irrigation-drainage systems on a regional scale, and may help reduce the capital needed to install such systems, lower irrigation costs, and reduce environmental effects associated with disposal of saline drainage water. (Doria-PTT)
W89-12422

BORON AND SALINITY SURVEY OF IRRIGATION PROJECTS AND THE BORON ADSORPTION CHARACTERISTICS OF SOME SASKATCHEWAN SOILS.
National Hydrology Research Inst., Saskatoon (Saskatchewan).
For primary bibliographic entry see Field 2K.
W89-12434

WATER RECLAMATION AND REUSE.
California State Water Resources Control Board, Sacramento.
T. Asano.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 841-844, June 1989. 74 ref.

Descriptors: *Wastewater treatment, *Water treatment, *Literature review, *Reclaimed water, *Water reuse, *Wastewater renovation, Feasibility, Public health, Aquaculture, Public opinion, Groundwater recharge, Planning.

Wastewater reclamation and reuse are reviewed, concentrating on 'big picture' developments and technologies which contributed more to water supply benefits than pollution control measures. The proceedings of the Water Reuse Symposium IV contained 89 papers and has shown that wastewater reclamation and reuse are both technically and economically feasible. Health risk issues related to water reuse have also been reviewed. Water reuse planning and analysis include market assessment and user contracts, feasibility, cost estimates, implementation of the reclaimed water uses for flushing toilets and urinals in high-rise office buildings, surveys of public acceptance, and agricultural water reuse. In the area of groundwater recharge and municipal wastewater reuse, projects in several U.S. cities were discussed. Industrial recycling and reuse projects include wastewater generated from heated caustic stripping baths; reuse of wastewater for industrial cooling systems; membrane technologies of microfiltration, ultrafiltration, and reverse osmosis for metal-finishing rinse water; and use of reclaimed municipal wastewater for energy station cooling, lake, wetland enhancement and power plant cooling, and industrial cooling systems. Recent technological developments are reported for toxicology testing; aquaculture wastewater treatment using water hyacinth, advanced water treatment, and energy recovery; and the selection of coagulants, their interaction with humic substances, and filtration. (White-Reimer-PTT)
W89-12516

EFFECT OF DIKES AND SULFURIC ACID ON COTTON UNDER EFFLUENT IRRIGATION.
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
For primary bibliographic entry see Field 5E.
W89-12639

GIARDIA AND VIRUS MONITORING OF SEWAGE EFFLUENT IN THE STATE OF ARIZONA.
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
J. B. Rose, R. De Leon, and C. P. Gerba.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 43-47, July 19, 1989. 3 tab, 15 ref.

Descriptors: *Water reuse, *Pollutant identification, *Monitoring, *Wastewater irrigation, *Wastewater treatment, *Viruses, *Enteroviruses, *Parasites, *Giardia, *Public health, Arizona, Filtration, Disinfection.

Arizona, located in the arid southwestern USA, is heavily dependent on groundwater. In order to protect this limited resource, wastewater reuse has been implemented. Virus and Giardia monitoring of wastewater used for irrigation has also been initiated as a means for controlling the public's exposure to these pathogens. Treatment facilities must produce wastewater with no detectable Giardia cysts and one virus plaque forming unit (pfu)/40 l for unrestricted reuse. For restricted reuse, 125 pfu/40 l is allowed. Methods based on filtration were used to monitor facilities at monthly, quarterly or biannual frequencies. Results after two years of monitoring are presented. All 11 treatment facilities produced water meeting the virus standard of 125 pfu/40 l. Only plants which used sand filtration and disinfection achieved consistent levels of virus below 1 pfu/40 L. Out of 70 samples, 74% contained no detectable viruses. Giardia was detected in 29-50% of the samples. Most plants would need to upgrade their treatment in order to meet standards for unrestricted irrigation. (Author's abstract)
W89-12784

WASTEWATER TREATMENT FOR EFFLUENT REUSE: LIME-INDUCED REMOVAL OF EXCRETED PATHOGENS.
Leeds Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-12790

STUDY OF MICROBIAL QUALITY AND TOXICITY OF EFFLUENTS FROM TWO TREATMENT PLANTS USED FOR IRRIGATION.
Universidad Politecnica de Valencia (Spain). Dept. of Hydraulic and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W89-12814

IMPACT OF WASTEWATER TREATMENT ON HELMINTH EGGS.
Nancy-1 Univ. (France). Faculte de Pharmacie.
For primary bibliographic entry see Field 5D.
W89-12827

MICROBIOLOGICAL ASPECTS OF FISH CULTURED IN WASTEWATERS: THE SOUTH AFRICAN EXPERIENCE.
Council for Scientific and Industrial Research, Pretoria (South Africa). Div. of Water Technology.
For primary bibliographic entry see Field 8I.
W89-12830

SAFETY ASSESSMENT OF BORON IN AQUATIC AND TERRESTRIAL ENVIRONMENTS.
Environmental Resources Ltd., London (England).
For primary bibliographic entry see Field 5C.
W89-12842

USE OF WASTEWATER EFFLUENT IN AGRICULTURE.
California Univ., Berkeley. Dept. of Civil Engineering.
W. J. Oswald.
Desalination DSLNAH, Vol. 72, No. 1/2, p 67-80, Apr/May 1989. 4 fig, 2 tab, 14 ref.

Descriptors: *Disinfection, *Water reuse, *Wastewater treatment, *Wastewater renovation, *Diseases, *Wastewater irrigation, *Irrigation practices, Forages, Cropland, Arid zone, Wastewater analysis, Complete wastewater treatment, Combined treatment, Viruses, Pathogenic bacteria, Parasites, Toxicity, Chlorination, Water properties, Stabilization ponds, Chemical treatment, Reclaimed water.

The use of domestic sewage and other liquid wastes for irrigation of food and forage crops has been under scrutiny for almost 100 years but the benefits, risks, and costs continue to be evaluated, particularly in arid zones. The physical, chemical, biological, and hygienic properties of wastewater vary greatly with method of treatment employed. Carefully designed complete systems involving multiple, in-series barriers against disease transmission are required. The shorter the time that elapses between production of a wastewater and its reuse for irrigation for food crops, the higher is the probability that it will transmit viral, bacterial, and parasitic diseases and/or convey toxicity. Because both activated sludge and trickling filtration are processes requiring little time, they have a high probability of disease transmission should disinfection fail. This probability can be greatly decreased by use of chlorine or ozone disinfection, but dosage must be adequate and completely uninterrupted, and the effluent must be dechlorinated to get rid of mutagenic or toxic chlorine derivatives. Thus systems which rely entirely on chemical disinfection are especially hazardous because they are vulnerable to human and natural failures. If wastewater is to be reclaimed for irrigation of forage crops, advanced integrated ponding followed by long-term storage in maturation ponds is fairly safe. Nevertheless the concept of using sewage on crops to be eaten raw has an element of peril that can never be overlooked. Its use on cereals and animal forage is much less perilous and a suitable quality can be achieved at a low cost in advanced integrated ponds. (Fish-PTT)
W89-13141

HEALTH CONSIDERATIONS IN USING TREATED INDUSTRIAL AND MUNICIPAL EFFLUENTS FOR IRRIGATION.
Ministry of Public Health, Safat (Kuwait). Environment Protection Dept.
M. Y. Abdulraheem.
Desalination DSLNAH, Vol. 72, No. 1/2, p 81-113, Apr/May 1989. 2 fig, 16 tab, 95 ref.

Descriptors: *Public health, *Treated water, *Industrial wastewater, *Municipal wastewater, *Wastewater renovation, *Wastewater irrigation, *Wastewater treatment, *Water reuse, *Pathology, Path of pollutants, Diseases, Tertiary wastewater treatment, Water quality standards, Water use, Water resources development, Desalination, Sanitary engineering, Soil-water-plant relationships, Soil properties, Percolation, Arid zone, Kuwait.

Wastewater from sewage treatment plants is a valuable resource in Kuwait, which can be made available for irrigation at a cost much lower than that for desalinated potable water. Kuwait's future plan for the use of treated wastewater is for forestry irrigation, fodder crops, and certain horticultural products. Tertiary treatment to the effluent from the three sewage works includes rapid gravity sand filtration with disinfection by chlorine before and after filtration. Most wastewater reclamation and reuse operations impose some risk to public or worker's exposure to pathogens or toxic substances. In general, the health concern is in proportion to the degree of human contact with the water, the quality of the effluent, and the reliability of the treatment processes. Good sanitary engineering practice results in control rather than total eradication of the disease agents. Virus inactivation, survival of enteric bacteria, migration of wastewater pathogens, and retention of trace elements in soil is dependent on several factors, including temperature, pH, organic matter content, antagonistic organisms, salts, suspended solids, transport by fauna, runoff, windblown soil, and percolation. The treatment and quality requirements for irrigation uses should be judged according to the situation. Direct human contact with the water should be avoided. Workers should be instructed about the potential for disease transmission and the precautions they should take. Tight controls should be imposed on transportation and distribution pipelines. The discharge of reclaimed water should be confined to the area designated and approved for discharge, and controlled to minimize ponding and runoff. Proper planning, operation, and maintenance of water-reclamation use areas is advantageous from economic, aesthetic, and health standpoints. (Fish-PTT)
W89-13142

TOWARDS THE USE OF INDUSTRIAL WASTEWATER FOR IRRIGATION IN KUWAIT.
College of Technological Studies, Shuwaikh (Kuwait).
I. Al-Shatti.
Desalination DSLNAH, Vol. 72, No. 1/2, p 115-124, Apr/May 1989. 4 fig, 1 tab, 26 ref.

Descriptors: *Kuwait, *Water resources development, *Wastewater irrigation, *Water reuse, *Wastewater renovation, *Industrial wastewater, Wastewater treatment, Desalination, Groundwater potential, Agricultural hydrology, Arid-zone hydrology, Economic aspects, Water quality standards, Marine environment.

The water resources in Kuwait are very limited. Groundwater exists in an aquifer stretching east of the Arabian peninsula and gently sloping towards the Gulf. Agricultural development depends mainly on groundwater. In recent years, however, the practice of protected agriculture (greenhouses) has spread, increasing the demand for desalinated water at escalating costs. Hence, there was a real need to search for a less expensive source of water to satisfy other uses than domestic. The Kuwait Institute for Scientific Research and the Shuaiba Area Authority have made a joint research study to protect marine ecology from industrial pollutants from wastewater discharged into the Gulf in the Shuaiba Industrial Area. Among their recommendations was the alternative of using such water for irrigation. The quality of the water does not seem to present major obstacles. However, the duration and the quantity of flows were not taken

into account. It is possible to add such a source to the present allocated amounts for irrigation, based on time series analysis of the quantities of industrial wastewater delivered from Shuaiba Refinery. Future work should be performed to capture water releases below the industrial discharge area. (Author's abstract)
W89-13143

POSSIBILITIES OF UTILIZING MUNICIPAL AND INDUSTRIAL WASTEWATER EFFLUENTS TO CONDITION SOIL.
Kuwait Inst. for Scientific Research, Safat.
For primary bibliographic entry see Field 5D.
W89-13144

3D. Conservation In Domestic and Municipal Use

WATER MANAGEMENT AND RECREATIONAL VALUES: SOME REAL CASES IN VICTORIA, AUSTRALIA.
Victoria State Rivers and Water Supply Commission, Armadale (Australia).
J. Paterson.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 1-12, 1989. 4 ref.

Descriptors: *Water management, *Water supply development, *Recreation, *Tourism, Lakes, *Australia, Wetlands, Estuaries, Salinity, Eutrophication, Sport fishing, Storage requirements.

The growing recognition of recreational and amenity demands on water systems introduces a multitude of issues, many of them complex, to the established tasks of water quality management and water management generally. Case studies from Victoria illustrate the range and diversity of situations that can arise in managing competition and enhancing compatibility between traditional water supply objectives and recreational demands. Fluctuation of storage levels, essential to storage operations, detract from recreational value. Recreational and tourism demands upon Lake Hume have grown to threaten traditional operating flexibility. Mokoan is another such instance, but with its supply function in a state of flux, Lake Mokoan provides more scope for a shift in the balance. Salinity management has become an issue in the management of lakes and wetlands when water supply interests and environmental/recreation interests respectively have different perspectives on salt disposal. Recreational use of town supply sources have long been a problem, although marked shifts in the attitudes of many supply authorities have occurred in recent years. Eutrophication of lakes and estuaries raises difficult issues of responsibility and scientific uncertainty, and the water management connection may be tenuous but will attract public attention. The water body attributes valued by specialized recreational interests require definition in terms that water managers can deal with using routine techniques of systems analysis and evaluation. The demands of the fish population and anglers introduce a new perspective in river management and perceptions of instream values are changing markedly. Direct costs of recreational services supplied by water authorities are not fully accounted: allocation choices and fiscal incidence will emerge as issue of significance. These case studies raise only a fraction of the total range of matters that will, in years to come, tax the technology and political skills of governments and management. (Author's abstract)
W89-12203

ENVIRONMENTAL POLICIES AT THE NATIONAL AND REGIONAL LEVELS: THE ROLE OF EPC, GCC AND ROPME.
Ministry of Public Health, Safat (Kuwait). Environment Protection Dept.
For primary bibliographic entry see Field 6E.
W89-13152

3F. Conservation In Agriculture

WINTER WHEAT RESPONSE TO WATER AND NITROGEN IN THE NORTH AMERICAN GREAT PLAINS.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2I.
W89-12333

ESTIMATING THE AGRICULTURAL RISKS OF TROPICAL RAINFALL.
For primary bibliographic entry see Field 2B.
W89-12341

CONSERVATION AND STORAGE OF SNOWMELT IN STUBBLE LAND AND FALLOW UNDER ALTERNATIVE FALLOW-STRIP CROPPING MANAGEMENT IN MONTANA.
Montana State Univ., Bozeman. Dept. of Plant and Soil Science.
J. M. Caprio, G. K. Grunwald, and R. D. Snyder.
Agricultural and Forest Meteorology AFMEEB, Vol. 45, No. 3/4, p 265-279, March 1989. 1 fig, 7 tab, 21 ref.

Descriptors: *Water conservation, *Strip cropping, *Farm management, *Soil water, *Water storage, *Snowmelt, *Montana, *Agricultural hydrology, *Cultivation, *Fallowing, Precipitation, Agriculture, Snow storage, Chinook, Recharge, Crop production, Snow.

The efficiency of stubble in augmenting soil water storage from snow entrapment was studied for small grain farms under alternate crop-fallow management in Montana. Nearly all the precipitation that falls during the winter period in the study area occurs in the form of snow. The term, snowmelt recharge efficiency (SRE), is used to indicate overwinter increase in soil water expressed as a percent of the total winter precipitation. This experiment was conducted on established fields under alternate fallow-strip cropping management in Montana during three winters (1976 to 1979) at 6.7 and 7 sites, respectively, extending over a north-south distance of about 320 km. About half of the sites were located in climatic areas characterized by relatively low chinook frequency and half in areas of high chinook frequency. There were three treatments: fallow, standing half stubble and standing full stubble. Soil water was measured to the 1.2-m depth in the autumn and again in the spring to compare the performance of the treatments in amount of soil water gain during the over-winter period. The study showed that SRE is significantly higher on the stubble treatments than on fallow. Since autumn soil water tends to be less in stubble than in fallow, much of the difference in SRE between fallow and stubble is attributed to the differences in autumn soil water levels. In the spring following the relatively dry first winter, there was still significantly less water in the soil in stubble areas than in fallow, but following the two wet winters, there was no significant difference. The larger SRE for stubble treatments during the dry winter indicates that more water entered the soil in stubble than in fallow, but recovery of soil water in stubble was fully recovered. While the increase in SRE in these wet years was due to the complete recovery of the autumn soil water deficit, it is not clear whether this deficit would have completely recovered had the stubble not been left standing. This study also revealed that SRE was generally greater in climatic areas characterized by few chinooks compared with areas of greater chinook frequency. (See also W89-12343) (Author's abstract)
W89-12342

EFFECTS OF CLIMATE ON POTENTIAL SOIL WATER GAIN FROM SNOWMELT IN STUBBLE AND FALLOW FIELDS.
Montana State Univ., Bozeman. Dept. of Plant and Soil Science.
J. M. Caprio, G. K. Grunwald, and R. D. Snyder.
Agricultural and Forest Meteorology AFMEEB, Vol. 45, No. 3/4, p 281-298, March 1989. 6 fig, 6 tab, 15 ref.

Descriptors: *Snowmelt, *Soil water, *Fallowing, *Agricultural hydrology, *Climates, Recharge, Snow, Cultivation, Agriculture, Precipitation, Wind, Chinook, Recharge, Grain crops, Montana, Strip cropping, Model studies.

The efficiency of stubble in augmenting soil water from snow on small grain farms was examined in Montana under alternate fallow-strip cropping and located in contrasting climatic areas for frequency of warm winter winds (chinooks) that contribute to snow-free conditions. Snowmelt recharge efficiency (SRE) under fallow and small grain stubble was measured at 2-3 wk intervals by installing and excavating mini-lysimeters containing oven-dried soil during three over-winter periods. SRE is defined as the mini-lysimeter catch of water expressed as a percent of the total precipitation that fell during the winter. Data from an average of five sites in the two climatic areas each year indicated that differences in SE were statistically significant at or near the 5% level for both climate (few vs. many chinooks) and treatments (fallow vs. stubble) only during the first and the third winters, and not during the second winter when the greatest amount of precipitation was recorded. On an average over the 3-yr period, SRE was about 12% greater in areas of fewer chinooks compared to areas of many chinooks and about 20% greater in full standing stubble compared to fallow. A model was developed from the 3 years of mini-lysimeter data giving relative SRE values of stubble compared to fallow for winters of different precipitation amounts. Another model was developed giving relative SRE values for areas of low chinook frequency compared to areas of high chinook frequency for winters of different precipitation amounts. (See also W89-12342) (Author's abstract)
W89-12343

RAINFALL PATTERNS IN RELATION TO PEAT EXTRACTION AND SILAGE MAKING.
University Coll., Dublin (Ireland).
For primary bibliographic entry see Field 2B.
W89-12345

IRRIGATION WATER MANAGEMENT FOR GUAR SEED PRODUCTION.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
W. L. Alexander, D. A. Bucks, and R. A. Backhaus.
Agronomy Journal AGJOAT, Vol. 80, No. 3, p 447-453, May-June 1988. 1 fig, 5 tab, 16 ref.

Descriptors: *Water requirements, *Drought resistance, *Semiarid lands, *Irrigation water, *Water management, *Crop production, *Guar seed, *Irrigation practices, *Irrigation effects, *Crop yield, Cultivation, Plant growth, Soil-water-plant relationships, Irrigation efficiency, Irrigation operation, Agricultural hydrology, Agriculture.

Agricultural crops with low water requirements and drought tolerance are needed for semiarid irrigation regions. Guar (Cyamopsis tetragonoloba (L.) Taub.) is promising as a crop for producing food-thickening agents and fluid additives for the oil drilling industry. The effects of irrigation timing, cultivar, and plant population on water use, growth, and yield of guar were investigated at Maricopa, Ariz., on a Mohall sandy loam soil (fine-loamy, mixed, hyperthermic Typic Haplargid) with a water salinity of 1.1 dS/m total dissolved salts over a 2-yr period. Variables were: six irrigation levels (one to four irrigations based on physiological plant growth stages), three cultivars ('Kinman,' 'Santa Cruz,' and 'Lewis'), and three populations (78, 26, and 13 plants/sq m). Three post-establishment irrigations--one before flowering, one during initial pod development, and one at mid-pod filling--were optimal. Four irrigations maximized vegetative growth but reduced seed production per unit of water use; two irrigations lowered growth, seed yield, and water use efficiency. Seed yields averaged 1567, 1650, and 1830 kg/ha for Kinman, Santa Cruz, and Lewis, respectively. Seasonal evapotranspiration was 400 mm on the optimal seed production treatments, and water use efficiencies were as high as 0.64 kg seed/cu m in

1983, and 0.41 kg seed/cu m in 1984. The newer Lewis has the potential for higher yields, in addition to being an attractive, low water-use summer crop for the southwestern United States. (Author's abstract)
W89-12347

DAILY AND SEASONAL EVAPOTRANSPIRATION AND YIELD OF IRRIGATED ALFALFA IN SOUTHERN IDAHO.
Agricultural Research Service, Kimberly, ID.
For primary bibliographic entry see Field 2D.
W89-12349

RESPONSE OF SOLID-SEEDED SOYBEAN TO FLOOD IRRIGATION: II. FLOOD DURATION.
Louisiana State Univ., Baton Rouge. Dept. of Plant Pathology and Crop Physiology.
J. L. Griffin, and A. M. Saxton.
Agronomy Journal AGJOAT, Vol. 80, No. 6, p 885-888, November-December 1988. 4 tab, 21 ref.

Descriptors: *Planting management, *Irrigation practices, *Flood irrigation, *Flood control, *Irrigation effects, *Soybeans, *Crop yield, *Soil-water-plant relationships, *Plant growth, Agricultural hydrology, Cultivation, Standing crop, Silt, Loam, Soil saturation.

Flood-irrigated soybean (Glycine max (L.) Merr.) can be exposed to extended periods of soil-saturated conditions, depending on the producers method of application, watering capacity, and field size. Field studies were conducted on a Crowley silt loam (fine, montmorillonitic, thermic Typic Albaqualf) soil in southwest Louisiana during 1982 to 1984 to evaluate the effects of flood duration on solid-seeded (i.e., nonbedded narrow rows) 'Ransom' soybean. Soybean was flooded at the V6 (vegetative), R2 (bloom), or R2 + R5 (bloom and pod fill) growth stages. Within each timing treatment, water was applied to a standing depth of 0.076 m and allowed to stand for 0 (nonflooded control), 1, 2, 4, or 8 d. Soybean stand density did not change as flood duration increased. Yields for individual timing treatments were generally similar when flood periods were 0, 1, or 2 d. When water was held longer than 2 d postflowering, significant yield reductions were noted in all years and were as much as 1390 and 1520 kg/ha in 1982, when water was applied at R2 or R2 + R5, respectively. In 1982 and 1984, when water was applied at R2 + R5, average yield reductions associated with increasing flood duration from 2 to 4 d and from 2 to 8 d were 20% and 10% higher, respectively, compared with R2 only. Increasing flood duration at V6 from 4 to 8 d decreased yields in 1982 and 1984 an average of only 340 kg/ha. For those 2 yr, with flood periods of 4 or 8 d, yields for soybean flooded at V6 were substantially higher than yields from the R2 or R2 + R5 treatments. Increased numbers of both seeds per pod and seeds per plant accounted for the higher yields in the V6 treatment. When flood irrigating solid-seeded soybean after flowering, attempts should be made to remove standing water within 2 d to avoid yield reductions. (Author's abstract)
W89-12351

WINTER WHEAT RESPONSE TO NITROGEN AND IRRIGATION.
Agricultural Research Service, Bushland, TX. Conservation and Production Research Lab.
H. V. Eck.
Agronomy Journal AGJOAT, Vol. 80, No. 6, p 902-908, November-December 1988. 1 fig, 6 tab, 12 ref.

Descriptors: *Irrigation effects, *Wheat, *Nitrogen, *Crop yield, *Cycling nutrients, *Water deficit, *Soil-water-plant relationships, Agricultural hydrology, Water stress, Irrigation practices, Nitrogen cycle, Dry farming, Plant growth, Plant growth substances.

Winter wheat (Triticum aestivum L.) is grown on the Southern Great Plains under dryland conditions and under varying irrigation regimes. Relationships between water and fertilizer needs are not well defined. Field studies were conducted to determine: (i) the interacting effects of N fertilization and irrigation on N and P needs, wheat yields, and yield components; and (ii) the effects of timing of water deficit periods on N and P needs, wheat yields, and yield components. Studies were conducted on a Pullman clay loam (fine, mixed, thermic Torrertic Paleustoll). Respective N and P rates ranged from 0 to 210 kg/ha and 0 to 40 kg/ha. Irrigations were applied or withheld to allow the crop to be nonstressed (I-1), stressed during heading and grain filling (I-2), stressed during tillering and jointing (I-3), and stressed throughout spring (I-4). Two-yr average data showed that 140 kg N/ha was sufficient for maximum grain yields on treatment I-1, while 70 kg N/ha was sufficient on treatments on I-2 and I-3, and no N response occurred on treatment I-4. Compared to treatment I-1, grain yields were 27, 32, and 52% less on treatments I-3, I-2, and I-4, respectively. Water use efficiency (WUE) increased with increments of N through 140 kg/ha on treatment I-1, and through 70 kg/ha on treatments I-2, and I-3 but applied N did not affect WUE on treatment I-4. In 1981, WUE was highest on treatment I-1 and lowest on treatment I-4; in 1982, however, WUE was highest on treatment I-4 and lowest on treatments I-1 and I-3. For limited irrigation, irrigating during tillering and jointing would be preferable to allowing stress then, and irrigating during heading and grain filling, because there is still potential for high yields if precipitation occurs during heading and grain filling. (Author's abstract)
W89-12352

LEAF WATER POTENTIAL, RELATIVE WATER CONTENT, AND DIFFUSIVE RESISTANCE AS SCREENING TECHNIQUES FOR DROUGHT RESISTANCE IN BARLEY.
Bangladesh Agricultural Univ., Mymensingh. Dept. of Soil Science.
M. A. Matin, J. H. Brown, and H. Ferguson.
Agronomy Journal AGJOAT, Vol. 81, No. 1, p 100-105, January/February 1989. 9 tab, 31 ref.

Descriptors: *Drought resistance, *Water potentials, *Plant water potential, *Leaves, *Barley, Cultivation, Diffusion, Crop yield, Water stress, Water deficiency, Evapotranspiration, Semiarid lands, Bangladesh.

Rapid drought resistance screening techniques could accelerate selection of improved cultivars for semiarid areas. It was investigated whether total leaf water potential, leaf relative water content, and leaf diffusive resistance could be used to differentiate between barley (Hordeum vulgare L.) cultivars differing in apparent drought resistance. Resistant and susceptible cultivars were selected by regressing individual cultivar yields against site mean yield for numerous yield trials. Individual plants were grown in cone-tainers (plastic tubes 25 mm in diameter and 123 mm long). The lower 30 mm of the cone-tainers were imbedded in sand so that roots emerging from the bottom of the cone-tainers were in the capillary fringe above a water table in the sand. Fifty plants were grown at a time in a sand bed, five replications each of five resistant and five susceptible barley cultivars of either two-row or six-row head types. At the three-leaf growth stage, total water potential was measured on the third leaf of each plant under low stress conditions (predawn). Water was then drained from the sand bed to stress the plants. Leaf diffusive resistant (LDR) was measured at 1000 and 1300 h each day as stress developed. When the PM diffusive resistance reached about 1000 s/m, relative water content (RWC) of the second leaf was determiend. All measurements were repeated in three different trials for each head type. Relative water content and total leaf water potential differentiated between drought-resistant and drought-susceptible groups of two-row and six-rowed barley at the 0.01 probability level in every trial. Leaf diffusive resistance differentiated between resistant and susceptible groups at the 0.01 or 0.05 level under low and high stress conditions. Neither RWC nor LDR allowed separation of cultivars within resistant or susceptible groups, but total leaf water potential did show differences between cultivars within groups. These techniques provide an easy method for screening for drought-resistant barley. (Author's abstract)
W89-12354

INFLUENCE OF CROP WATER ENVIRONMENT AND DRY MATTER ACCUMULATION ON GRAIN YIELD OF NO-TILL WINTER WHEAT.
Saskatchewan Univ., Saskatoon. Crop Development Centre.
For primary bibliographic entry see Field 2I.
W89-12366

ECONOMIC INCENTIVES FOR IRRIGATION DRAINAGE REDUCTION.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
J. Letey, A. Dinar, and K. C. Knapp.
California Agriculture CAGRA3, Vol. 42, No. 3, p 12-13, May-June 1988. 1 fig.

Descriptors: *Pricing, *Irrigation efficiency, *Drainage, Economic aspects, Monitoring, Evapotranspiration, Taxes, Irrigation, Cotton, Profit, Crop yield.

Water quality objectives for agricultural drainage waters in California could be achieved without treatment of agricultural drainage water if subsurface drainage from existing tile-drained areas in the drainage study area were reduced from the existing 0.7 acre-foot per acre (8.4 inches) to 0.45 acre-foot per acre (5.4 inches). A research project was conducted analyzing economic incentives that might lead to adoption of the recommended practices. Rather large reductions in drainage volumes can be induced by the tiered pricing policy with a relatively small decrease in profitability because of the very strong incentive to apply very little water at the premium price. The tiered water pricing policy is clearly superior to the flat rate policy when the only purpose is to motivate drainage flow reduction. Increasing the irrigation water price above the base level by either policy would result in surplus revenues from the sale of irrigation water. Return of the 'surplus' to the farmers would not reduce their incentive to reduce drainage volumes, because their payments would be based on irrigation amount and returns on irrigated area, regardless of applied water. This approach would penalize poor water management and benefit good water management, because the good manager could receive a larger monetary refund than was paid for the premium-priced water. Indeed, this policy rewards the good farmers, whereas the better farmers tend to be comparatively penalized in a system that directs the economic incentives to the agricultural community as a whole rather than to individual farmers. (Doria-PTT)
W89-12423

DRAINAGE SYSTEM PERFORMANCE AFTER 20 YEARS.
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. E. Grismer, I. C. Tod, and F. E. Robinson.
California Agriculture CAGRA3, Vol. 42, No. 3, p 24-25, May-June 1988. 2 fig.

Descriptors: *Drainage systems, *Agricultural engineering, *Pipes, *Materials testing, Clays, Concretes, Hydrographs, Flow rates, Irrigation, Performance evaluation.

As part of a study of the longevity and effectiveness of clay, bituminous fiber, and concrete drainage pipes, several pairs of these pipes were installed in a heavy clay soil at the Imperial Valley Agricultural Center at El Centro, CA in January 1964. Drain lines were laid at a depth of 7 feet and a spacing of 120 feet. Bituminous-fiber drains were installed in a fiberglass envelope; washed gravel was used to enclose the clay and concrete pipes. In June 1987, three new corrugated plastic drainlines were installed with gravel envelopes. The new drains were placed within 10 feet of the old drains. The performance of the old drainage system was investigated, comparing it with a newly installed system, and the status of the original drainline materials as part of a larger study related to infil-

tration and drainage of cracking clay soils was examined. Results of this evaluation suggest that bituminous fiber drainlines in a fiberglass envelope degraded over time, but little degradation was found in the clay drainlines. Despite deterioration of the bituminous fiber drainlines, there was little difference in performance between clay and bituminous fiber drainlines. Drainage system performance declines over the 20-year period as compared with newly installed plastic drainlines and with the old drains when originally installed. Lack of substantial change in load-flow relationships between old and new drains suggests that higher flow rates in the new drains should remove a greater quantity of salts from the root zone. Such removal may improve crop production in this soil. (Doria-PTT)
W89-12424

BENEFITS AND COSTS OF IMPROVING PUMPING EFFICIENCY.
California Univ., Davis. Dept. of Land, Air and Water Resources.
B. R. Hanson.
California Agriculture CAGRA3, Vol. 42, No. 4, p 21-22, July-August 1988. 3 fig, 1 tab.

Descriptors: *Cost-benefit analysis, *Pumps, *Maintenance, *Irrigation efficiency, Costs, Energy, California.

Today's energy costs require growers to operate their irrigation pumping plants as efficiently as possible. It is well known that repairing or replacing an inefficient pump is beneficial, but little documentation exists on the benefits versus costs of improving efficiency. Growers need such information to determine the economic feasibility of any improvements. A study of the benefits and costs of increasing pump efficiency was therefore conducted in the central coastal area of California. Substantial improvements in pump performance resulted from repairing or replacing the pumping plant. In the study area, California's Central Coast, the primary improvement was increased pump capacity. The benefit of such improvements, however, depends on management of the irrigation system. If the same operating time is continued after the repair/replacement, little or no energy savings will occur and the primary benefit will be an increase in crop yield. If, however, the same volume of water is applied before and after the repair, an energy savings might be expected. Growers should not expect energy savings from improved pumping efficiency unless the horsepower demand is reduced or the operating time is decreased. Horsepower demand can be reduced by replacing a pump that is not operating at maximum efficiency for a given total head and capacity with a pump that is properly matched with the desired total head and capacity. The operating time can be decreased by reducing set times to prevent overirrigation, increasing the uniformity of the irrigation system, and improving irrigation scheduling. (Doria-PTT)
W89-12425

IRRIGATION AND DRAINAGE STRATEGIES IN SALINITY PROBLEM AREAS.
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. E. Grismer, T. K. Gates, and B. R. Hanson.
California Agriculture CAGRA3, Vol. 42, No. 5, p 23-24, September-October 1988. 1 fig, 3 tab.

Descriptors: *Irrigation practices, *Drainage practices, *Salinity, San Joaquin Valley, Economic aspects, Simulation, Model studies, Water table, Root zone, Crop yield, Profit, Water storage, Evapotranspiration, Precipitation, Percolation, Aquifers, Leakage, Costs, Irrigation efficiency, Permeability, Flow.

Long-term reduction of saline high water tables that cause problems in the western San Joaquin Valley requires simultaneous irrigation and drainage management. Sufficient water must be supplied for crop needs and leaching of salts, while drainage is required to remove water leached from the crop root zone. Water table levels must be deep enough to minimize waterlogging and upward flow of salts to the root zone. A simulation model was used to determine optimal irrigation and drainage strategies in a hypothetical region of the San Joaquin Valley. Possible field methods and operations necessary to address the best regional water management strategy are also considered. These modeling efforts suggest that the primary process affecting crop yield and economic return to growers are water application efficiency, salinity control in the root zone, and soil permeability. Of particular importance in salinity control is upward flow from the saline water table. Model results also indicated that, when water delivery schedules result in relatively infrequent applications, surface irrigation systems operated at efficiencies near 80% can yield the greatest net benefits to growers in salinity problem areas. Where water delivery schedules are not a limitation, salinity control and a reduction in drainage water may be achieved by very frequent water applications with highly uniform irrigation systems. (Doria-PTT)
W89-12426

SOLUBLE CALCIUM COMPOUNDS MAY AID LOW-VOLUME WATER APPLICATION.
California Univ., Davis. Dept. of Land, Air and Water Resources.
W. E. Wildman, W. L. Peacock, A. M. Wildman, G. G. Goble, and J. E. Pehrson.
California Agriculture CAGRA3, Vol. 42, No. 6, p 7-9, November-December 1988. 2 fig, 3 tab.

Descriptors: *Calcium compounds, *Irrigation efficiency, *Infiltration, San Joaquin Valley, Orchards, Vine crops, Gypsum, Drip irrigation, Calcium chloride, Citrus fruits, Acidity, Fertilizers, Nitrates.

Slow water infiltration is a serious problem in some orchards and vineyards on the east side of the San Joaquin Valley. The objective of this research was to increase water infiltration in a drip-irrigated citrus orchard. Soluble calcium compounds and other amendments either to the irrigation water or to the soil were applied. These experiments confirm the hypothesis that soluble calcium compounds, added continuously in the irrigation water, can double or triple the infiltration rate over that of untreated low-salt water. There is also strong evidence that occasional additions of calcium nitrate or CAN-17 are not effective in maintaining high infiltration rates. The pH increase with calcium acetate suggest that this salt could be used to compensate for the acidifying effects of nitrogen fertilizers injected into drip systems, while improving water infiltration. It was also found that preparing and adding concentrated calcium solutions to drip-irrigation systems is practical. Rates of 120 gallons of a concentrated solution of calcium nitrate or chloride or 80 gallons of CAN-17 will add 3 meq/L to an acre-foot of water. About 400 gallons of calcium acetate solution would be required because of the somewhat lower solubility of that salt. In contrast, it would take 35,000 gallons of a saturated gypsum solution to add the same 3 meq/L to an acre-foot of water. (Doria-PTT)
W89-12427

EFFECT OF CROP ROTATION AND FERTILIZATION ON THE QUANTITATIVE RELATIONSHIP BETWEEN SPRING WHEAT YIELD AND MOISTURE USE IN SOUTHWESTERN SASKATCHEWAN.
Agriculture Canada, Swift Current (Saskatchewan). Research Station.
C. A. Campbell, R. P. Zentner, and P. J. Johnson.
Canadian Journal of Soil Science CJSSAR, Vol. 68, No. 1, p 1-16, February 1988. 5 fig, 6 tab, 33 ref.

Descriptors: *Crop production, *Fertilization, *Wheat, *Crop yield, *Water use, *Saskatchewan, Precipitation, Distribution, Sampling, Pan evaporation, Mathematical equations, Temperature, Wind, Radiation, Nutrients, Nitrates.

The effects of crop rotation and fertilization on the quantitative relationship between spring wheat yields, available spring soil moisture, and growing season precipitation were determined from an experiment conducted on a loam soil in southwestern Saskatchewan during 1967-1984. Stubble-seeded wheat required 68 mm of moisture to produce the first kilogram per hectare of grain; fallow-seeded wheat required about 46 mm. There was no effect of fertilizer on these lower threshold values, but the yield increase per mm of moisture used tended to be greater for the better fertilized rotations. The lower threshold level of moisture used for grain production cited above (68 mm and 46 mm) represents a marked decrease from the 140 mm reported for the period 1925-1950; this has resulted in substantially greater moisture use efficiency in recent years, probably due to better, more timely crop management and the improved cereal varieties now used. The grain filling period was confirmed as the most important for the occurrence of precipitation for both fallow-seeded and stubble-seeded wheat, but precipitation at or near seedling time was almost as important for stubble-seeded wheat since this ensures the establishment of an adequate plant stand. (Doria-PTT)
W89-12432

DIFFERENTIAL GENOTYPIC RESPONSE TO DROUGHT STRESS AND SUBSOIL ALUMINUM IN SOYBEAN.
Wisconsin Univ.-Madison. Dept. of Agronomy.
I. L. Goldman, T. E. Carter, and R. P. Patterson.
Crop Science CRPSAY, Vol. 29, No. 2, p 330-334, March-April 1989. 3 tab, 25 ref.

Descriptors: *Drought resistance, *Stress, *Aluminum, *Soybeans, *Subsoil, Crop production, Plant physiology, Metabolism, Toxicity, Greenhouses, Saturation, Soil water, Water potentials, Moisture content, Leaves, Transpiration, Soil-water-plant relationships.

Soybean (Glycine max) producers in the southeastern USA are often confronted with the problems of drought and toxic levels of subsoil aluminum. The objective of this study was to determine the reaction of diverse soybean genotypes to combined effects of these two stress factors. Greenhouse studies were initiated to examine the problem. Two levels of Al saturation in a subsoil layer (6 and 71%), two levels of soil moisture (watered vs. unwatered), three genotypes ('Forrest', breeding line N77-114, and PI 416937), and three sampling dates were used as treatments. Data were collected during a 14-d drying cycle imposed at early to midpodfilling. Control pots were watered daily. Traits measured were relative water content, water potential, transpiration, diffusive resistance, leaf weight, and stem weight. In the combined presence of drought and Al stress, the Plant Introduction (PI) maintained a substantially higher relative water content, water potential, transpiration, and leaf weight than Forrest or N77-114. Under drought stress alone, the water status of the PI was inferior to that of Forrest and N77-114. These data suggest that Al tolerance can impart drought tolerance when subsoil Al is present. In regions where subsoil Al toxicity and drought are common, breeders should consider Al screening of germplasm to characterize and develop drought tolerant cultivars efficiently. (Author's abstract)
W89-12437

DROUGHT EFFECT ON LEAF CONDUCTANCE AND LEAF ROLLING IN FORAGE GRASSES.
Agriculture Canada, Agassiz (British Columbia). Research Station.
For primary bibliographic entry see Field 2I.
W89-12438

INFLUENCE OF WATER MANAGEMENT ON GROWTH AND YIELD OF NO-TILL PLANTED RICE.
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2I.
W89-12440

SYSTEMS ANALYSIS OF TANK IRRIGATION: I. CROP STAGGERING.
Karnataka Regional Engineering Coll., Suratkal (India).

S. G. Mayya, and R. Prasad.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 384-405, June 1989. 4 fig, 9 tab, 18 ref, append.

Descriptors: *Systems analysis, *Reservoirs, *Irrigation water, *Crop production, *Irrigation practices, *Irrigation design, Irrigation engineering, Agriculture, Rural sociology, Rural areas, Agronomy, India, Farming, Model studies, Available water, Food habits, Livestock, Social values.

The irrigation potential of a tank system, thousands of which are found in South India, depends upon a number of factors other than water availability. These factors are mainly influenced by the agricultural technology adopted, food practices of people and livestock, the interdependence of land-human-livestock components of life, and socioeconomic practices prevailing in rural areas. The system needs to pertain not only to grain yield but also to fodder production. In semiarid regions of India, uneven distribution and insufficient rainfall during the initial crop season develops water stress in plants. Relatively higher irrigation efficiency, which is possible to attain in tank systems, leads to an increase in the energy resources required for various agricultural operations. The effect of these factors is investigated on the optimal use of irrigation potential of a minor irrigation tank system. The method involves developing a linear programming (LP) model to optimize the net profit from the system and to determine the optimal cropping pattern under the influence of various parameters, determine the optimal cropping pattern under the influence of various parameters, e.g. animal power, labor, fodder production, the resources of farmers, and the nutritional energy requirement of the system, in addition to water availability. The crucial nature of these factors as well as the irrigation efficiency is analyzed. The solution reveals the effectiveness of prevailing agricultural practices consistent with the availability of water resources in the initial crop season. (See also W89-12635) (Author's abstract)
W89-12634

SYSTEMS ANALYSIS OF TANK IRRIGATION: II. DELAYED START AND WATER DEFICIT.
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
R. Prasad, and S. G. Mayya.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 406-420, June 1989. 1 fig, 7 tab, 8 ref, append.

Descriptors: *Systems analysis, *Reservoirs, *Irrigation water, *Irrigation efficiency, *Water deficit, *Irrigation practices, *Agriculture, Irrigation engineering, Irrigation design, Soil water deficiency, Crop yield, Agronomy, India, Farming, Semiarid lands, Cultivation, Water importing.

Tank irrigation systems in the semiarid regions of India are reviewed. To optimize the grain yield of rice, it is essential to start the agricultural operations in the second week of July so that favorable climatic conditions will prevail during flowering and yield formation stages. Because of low inflow during the initial few weeks of the crop season, often farmers are forced to delay planting until sufficient sowing rain and inflow have occurred or to adopt deficit irrigation during this period. The delayed start affects the grain yield, but will lead to an improved irrigation efficiency. A delayed start of agricultural operations with increased irrigation efficiency leads to the energy resources becoming critical during the peak requirement week, particularly those of female labor and animal power. This necessitates augmenting these resources during weeks of their peak use, either by reorganizing the traditional methods of cultivation or by importing from outside the system. (See also W89-12634) (Author's abstract)
W89-12635

RESEARCH IMPERATIVES FOR IRRIGATION SCIENCE.
Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant Physiology.
B. E. Clothier.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 421-448, June 1989. 15 fig, 120 ref.

Descriptors: *Research priorities, *Literature review, *Irrigation, *Irrigation engineering, *Irrigation design, Agriculture, Reviews, Crop production, Root zone, Vadose zone, Aeration zone, Soil water, Economic aspects, History, Future planning, Technology.

The history, current science, and future demands of irrigation science are reviewed. Economic and environmental pressure requires efficient use of any water intended for irrigation. Irrigation over the next decade will be assisted in this push for efficiency by the pull of research and technology. Six areas of existing research are identified as being critical for creating the understanding necessary for generating greater irrigation efficiencies. In crop meteorology, they are stomatal behavior and crop evaporation, local advection in aerially confused environments, and regional ET estimation; in soil physics, they are small and large-scale soil variability, redistribution of water in the root zone following irrigation, and chemical movement by soil water. Further, it is suggested that the two research fronts of root behavior and direct or remote sensing of crop plants are currently underdeveloped. Expansion in these areas will be crucial in order to create efficient irrigation by the year 2000. Novel techniques, often assisted by new technology, will enhance the pace of acquisition of additional scientific understanding, although the best tool will remain the accepted scientific principles of incisive thinking and perceptive experimentation. (Author's abstract)
W89-12636

PARTICLE FILTRATION FOR WASTEWATER IRRIGATION.
Hebrew Univ. of Jerusalem (Israel). Human Environment Sciences Div.
For primary bibliographic entry see Field 5E.
W89-12640

STOCHASTIC APPROXIMATION APPLIED TO OPTIMAL IRRIGATION AND DRAINAGE PLANNING.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
T. K. Gates, R. J. B. Wets, and M. E. Grismer.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 488-502, June 1989. 2 fig, 2 tab, 29 ref. append.

Descriptors: *Optimum development plans, *Irrigation, *Drainage, *Stochastic process, *Model studies, *Water management, *Surface-groundwater relations, Economic aspects, Irrigation districts, Irrigation effects, Planning, Agriculture, Farming, Soil water, Geohydrology, Groundwater movement, Hydraulic properties, Computers.

Parameter uncertainty in modeling complex hydrologic systems has resulted in development of stochastically based water management models. Optimal solutions to such models, particularly those have parameters with large variance, may be difficult, if at all possible, to obtain, due to intensive computational requirements. Application of a stochastic quasigradient (SQG) approximation method to a management model is presented. The model describes the effects of regional irrigation and drainage system planning on shallow saline groundwater behavior and net economic returns to farmers. Due to the complexity and large parameter variance originating from spatial variability in soil hydraulic properties, the SQG method obtained near-optimal solutions in about 15% of the CPU time required to obtain such solutions using response surface technology. (Author's abstract)
W89-12641

THREE-POINT METHOD FOR ESTIMATING CUT AND FILL VOLUMES OF LAND GRADING.
Lakehead Univ., Thunder Bay (Ontario). Dept. of Civil Engineering.
S. M. Easa.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 505-511, June 1989. 4 fig, 6 ref.

Descriptors: *Grading, *Construction methods, *Land reclamation, *Terracing, *Land forming, *Earthworks, Landscaping, Land development, Soil engineering, Computers, Cost analysis, Hydraulic structures, Land management, Construction, Costs, Estimating, Cut and fill.

In land-grading design, cut and fill volumes are required to account for the shrinkage of soil during the design process and, after the design has been accomplished, to estimate the cost of earthwork. A three-point (TP) method for computing cut and fill volumes for triangular and rectangular grids is developed. Advantages of the TP method include applicability to a triangular grid for which no volume estimation method is available, and applicability to a rectangular grid allowing unequal intervals to be used in establishing the land grading grid. The TP method can be easily implemented in existing landgrading design models. The four-point (FP) method is not accurate when the ground surface within the (square) grid is not a plane but is reasonably accurate when it is. However, since the TP method is more accurate, it is recommended for use even when the ground surface within the square grid is a plane. (Friedmann-PTT)
W89-12642

SOME FURTHER EVIDENCE ON THE DERIVED DEMAND FOR IRRIGATION ELECTRICITY: A DUAL COST FUNCTION APPROACH.
Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 6D.
W89-12973

WATER UPTAKE BY COTTON ROOTS DURING FRUIT FILLING IN RELATION TO IRRIGATION FREQUENCY.
Agricultural Research Service, Phoeniz, AZ. Western Cotton Research Lab.
For primary bibliographic entry see Field 2I.
W89-13136

USE OF WASTEWATER EFFLUENT IN AGRICULTURE.
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3C.
W89-13141

TOWARDS THE USE OF INDUSTRIAL WASTEWATER FOR IRRIGATION IN KUWAIT.
College of Technological Studies, Shuwaikh (Kuwait).
For primary bibliographic entry see Field 3C.
W89-13143

POSSIBILITIES OF UTILIZING MUNICIPAL AND INDUSTRIAL WASTEWATER EFFLUENTS TO CONDITION SOIL.
Kuwait Inst. for Scientific Research, Safat.
For primary bibliographic entry see Field 5D.
W89-13144

AGRICULTURAL ACHIEVEMENTS AND IRRIGATION MANAGEMENT IN KUWAIT.
Kuwait Agriculture Affairs and Fish Resources Authority, Safat.
L. Savvides.
Desalination DSLNAH, Vol. 72, No. 1/2, p 207-214, Apr/May 1989.

Descriptors: *Water resources development, *Agricultural hydrology, *Kuwait, *Agricultural engineering, *Arid-zone hydrology, *Irrigation programs, Groundwater quality, Farming, Vegetable crops, Desalination, Seawater, Brackish water, Wastewater, Education, Irrigation efficiency, Irri-

gation water, Drip irrigation, Sprinkler irrigation, Leaching, Salts.

Kuwait has limited water resources and its agricultural program is faced with two major problems: (1) the hot weather during summer, and (2) the poor quality of groundwater. In spite of the adverse conditions, impressive achievements have been made during recent years. Almost 5000 hectares of farmland is cultivated every year mainly with vegetables. Protected vegetables in plastic houses are grown well with the newest technology for maximum yields and efficient utilization of irrigation water. Three types of irrigation water are used in agriculture: sweet (desalinated seawater), brackish, and treated sewage. Important aspects to be considered are the proper education of farmers, installation of appropriate irrigation systems (properly designed, operated and maintained), and proper irrigation scheduling of crops. Training of staff must be on a continuous basis to ensure that advanced technology is well introduced and properly applied for the efficient use of all production resources, especially irrigation water, which is the limiting factor for expanding agriculture. The recommended irrigation system is drip for vegetables, bubbler for trees, and sprinkler for fodder crops. Leaching of salts is an absolute necessity for keeping up the soil productivity. (Author's abstract)
W89-13150

MODIFIED SYSTEM OF SUBSIDIZING DISTILLED WATER IN KUWAIT.
College of Technological Studies, Shuwaikh (Kuwait).
F. Z. Elshibini, and G. A. Al-Nakshabandi.
Desalination DSLNAH, Vol. 72, No. 1/2, p 235-246, Apr/May 1989. 3 fig, 6 tab, 32 ref.

Descriptors: *Kuwait, *Subsidies, *Government supports, *Agricultural hydrology, *Agricultural engineering, *Distilled water, *Water costs, *Water management, Cost analysis, Economic aspects, Domestic water, Water demand, Water supply, Industrial water, Irrigation water, Arid-zone hydrology, Crop production.

The adverse climatic conditions and soil constraints in Kuwait, as well as the traditional methods used to distribute and apply irrigation water, decrease irrigation efficiency and crop quality. The problem is partially solved by introducing new technologies of water handling and application under controlled cultural practice. Farmholders have been allowed to cover 20% of their land with greenhouses. This shifting to non-conventional methods of crop production increased the demand on distilled water. The demand on distilled water also increased with the new development in industries. Moreover, the rate of domestic use of water increased with the new increased standard of living. The cost of water in Kuwait is highly subsidized for all uses by the government. Among the most efficient measures of reducing waste, and improving efficiency of distilled water use, is to introduce subsidy on a modified basis, thus arriving at a balanced economic-financial cost of this vital commodity. (Author's abstract)
W89-13153

ESTIMATED LONG-TERM SOIL MOISTURE VARIABILITY ON THE CANADIAN PRAIRIES.
Agriculture Canada, Ottawa (Ontario). Land Resource Research Centre.
For primary bibliographic entry see Field 2G.
W89-13182

EFFECTS OF AGRICULTURAL WATER TABLE MANAGEMENT ON DRAINAGE WATER QUALITY.
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W89-13320

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

WIMMERA RIVER (VICTORIA, AUSTRALIA: INCREASING USE OF A DIMINISHING RESOURCE).
Horsham City Engineer's Dept. (Australia).
For primary bibliographic entry see Field 5G.
W89-12237

ECOLOGICAL PROBLEMS IN CONNECTION WITH SMALL RIVERS (EKOLOGICHESKIE PROBLEMY EKSPLUATATSII MALYKH REK).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. I. Merezhko.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 23, No. 1, p 3-8, 1987. 23 ref. English summary.

Descriptors: *Water pollution control, *Watershed management, *Water resources development, *River basin development, *Small watersheds, River systems, USSR, Swamps, Irrigation water, Saline soils, Salinity, Resource allocation, Natural resources, Economic aspects.

Proper management of the water resources of the USSR requires important decisions about small rivers which have been intensively exploited but very little studied. Some of the problems which need to be considered include: (1) redistribution of the available water volume of small rivers for irrigation use; (2) the effect of drying up of rivers on the watershed ecosystem; (3) clarification of the role of swamps in the ecosystems of small rivers; and (4) analysis of such processes as flooding, and salinization of the land due to irrigation. A more rational use of the natural resources in small river basins is necessary. There has been a lack of methods based on ecological principles. The most important problems are caused by the intensive use of the natural resources of small watersheds and the application of economic methods for immediate return. (Peters-PTT)
W89-12265

EFFECT OF SURFACTANTS ON THE GROWTH OF ALGAE (VLIIANIE POVERKHNOSTNO-AKTIVNYKH VESHCHESTV NA VODOROCLI) (OBZOR).
Donetskii Gosudarstvennyi Univ. (USSR).
For primary bibliographic entry see Field 5C.
W89-12275

SPHAGNUM AND CELLULOSE DECOMPOSITION IN DRAINED AND NATURAL AREAS OF AN ALBERTA PEATLAND.
Alberta Univ., Edmonton. Dept. of Forest Science.
For primary bibliographic entry see Field 4C.
W89-12452

STOCHASTIC APPROXIMATION APPLIED TO OPTIMAL IRRIGATION AND DRAINAGE PLANNING.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W89-12641

CONTROLLING SEEPAGE FROM EVAPORATION PONDS.
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 5G.
W89-13044

URBAN STORMWATER REDUCTION AND QUALITY IMPROVEMENT THROUGH THE USE OF PERMEABLE PAVEMENTS.
Trent Polytechnic, Nottingham (England). Dept. of Civil and Structural Engineering.
C. J. Pratt, J. D. G. Mantle, and P. A. Schofield.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 769-778, 1989. 10 fig, 1 tab, 7 ref. Science and Engineering Council grant GR/D/91724.

Descriptors: *Runoff volume, *Water quality management, *Permeable pavements, *Urban hydrology, *Paving, *Storm water, *Urban runoff, Cements, Permeability, Sewer systems, Concretes, Stormwater reduction, Maintenance, Urban watersheds.

The preliminary results from a study of a permeable pavement, using various construction materials, show that both useful flow reduction and peak discharge attenuation can be achieved, even in circumstances where stormwater was collected via sub-base drains for discharge off-site. Effluent quality has been found to be markedly better than typically monitored from urban, impermeable highway surfaces in similar residential areas, and there exists the opportunity for the design of construction and choice of materials to effect quality enhancement. The reduced effluent discharge, combined with lower pollutant concentrations, means much reduced pollutant loads are passed to receiving waters. Permeable pavements have not been employed sufficiently for reliable estimates to be made of their effective working life and maintenance demands to be established. Therefore, these questions remain unanswered and are generally interpreted as disadvantages. The advantages of wider use of such pavements are beginning to be quantified. In the wider context of urban drainage basins problems are clearly evident: (1) hydraulic over-loading of sewers leading to early structural deterioration; (2) higher sewer flows causing frequent storm overflow operations; and (3) untreated discharge of urban stormwater after the introduction of separate sewerage systems, producing continuing adverse effects on urban watercourses. Pre-meable pavements may help ameliorate such problems. (Miller-PTT)
W89-13054

FLOODPLAIN-MANAGEMENT PLAN ENUMERATION.
Hydrologic Engineering Center, Davis, CA.
D. T. Ford, and A. Oto.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 4, p 472-485, July 1989. 4 fig, 5 tab, 21 ref.

Descriptors: *Flood plain management, *Expert systems, *Flood routing, *Management planning, *Systems analysis, Simulation, Hydrologic models, Branch-and-bound enumeration procedure, Optimization, Levees, Computer programs, Rivers.

A branch-and-bound enumeration procedure improves the search for an optimal floodplain management plan. The procedure considers all combinations of expert-defined alternative measures. However, through bounding, it eliminates inferior combinations without exhaustive detailed evaluation. In cases for which detailed evaluation is required, it is proposed that Hydrologic Engineering Center system-simulation, economic analysis, or data-management software be used. The branch-and-bound procedure is demonstrated using an example of a hypothetical floodplain protected by a major levee. The levee restricts runoff into the river, so that the interior area may flood. Forty-five plans were possible for this site based on the information contributed to the procedure. Only 13 were explicitly evaluated because the other 32 were excluded by comparison of the computed bound with the trial-optimal objective function. The branch-and-bound procedure has distinct advantages in plan formulation. Alternatives can be nominated that cover such areas as technical, financial, social, environmental, and political objectives and constraints. Another advantage claimed for the branch-and-bound procedure is that it is understandable to non-experts. (Rochester-PTT)
W89-13127

LAKE CHICOT: THE FINAL CHAPTER.
Army Engineer District, Vicksburg, MS.
For primary bibliographic entry see Field 5G.
W89-13240

WATER QUALITY EVALUATION OF PROPOSED OUTLETS FROM DEVILS LAKE NEAR DEVILS LAKE, ND.
Army Engineer District, St. Paul, MN.
D. D. Holme.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 83-94, 13 fig, 1 ref.

Descriptors: *Water quality control, *Flood control, *Water quality, *Water resources development, *Devils Lake, *Model studies, Sheyenne River, Water level, Dissolved solids, Saline lakes, North Dakota, Sulfates, Evaporation.

The St. Paul District is conducting feasibility studies for flood damage reduction and other purposes in the Devils Lake basin, a closed subbasin of the Red River of the North watershed in northeastern North Dakota. Among the alternatives considered were several possible outlet alignments that would permit controlling the upper limit of the lake surface at some desirable elevation by creating an outlet to the Sheyenne River. Some of the possible alignments were eliminated due to economic or political constraints. The feasibility of the remaining outlet alternatives will be determined largely on the basis of water quality considerations because Devils Lake is salty. The Devils Lake dissolved mineral dynamics are described with respect to recent lake level fluctuations. Models have been developed for predicting the effects of a continued lake-level rise and the routing of Devils Lake releases through a downstream river and reservoir system. The water quality study has focused primarily on predicting total dissolved solids (TDS) and sulfate concentrations in the lake chain and downstream under various outlet operating scenarios. It involved the development of three mass balance models for: (1) predicting the in-lake freshening effects of an indefinite continuation of the recent rising trend with and without the operation of an outlet; (2) routing of Devils Lake discharges through Lake Ashtabula Reservoir to Kindred, ND, on the Sheyenne River; and (3) routing the affected Sheyenne River water down the Red River of the North to Emerson, Manitoba. The Devils Lake model indicated that as the lake level approaches 1440 ft, the marginal evaporation, a function of increasing surface area, approaches the inflow volume, and no further rise occurs. West Bay and East Bay would probably continue to freshen somewhat during the next 40 yrs but would begin to concentrate again after that. The current concentrating trend of East Devils Lake would continue indefinitely. The Sheyenne River model indicated that releases from East Bay and East Devils Lake will result in TDS concentrations in Lake Ashtabula exceeding 4000 mg/L and 8000 mg/L, respectively. These high TDS concentrations are of particular concern considering that nearly 50% of the Devils Lake TDS is sulfate. (See also W89-13231) (Lantz-PTT)
W89-13242

POTENTIAL FOR HYDRILLA DISPERSAL BY SEXUAL MEANS IN NORTH CAROLINA SURFACE WATERS.
North Carolina State Univ. at Raleigh. Dept. of Crop Science.
K. A. Langeland, and C. B. Smith.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-193403/AS. Price codes: A03 in paper copy, A01 in microfiche. North Carolina Water-Resources Research Institute, Raleigh, Completion Report No. 240, November 1988. 22p, 2 fig, 4 tab, 25 ref. State project 70059.

Descriptors: *Aquatic weed control, *Hydrilla, *Reproducibility, *Seeds, *North Carolina, Aquatic weeds.

Flowering and seed producting of monoecious hydrilla populations in several North Carolina lakes were studied and eleven populations of hydrilla in the United States were karyotyped. Flowering did not occur when plants were maintained in a phytotron for two months under a variety of day lengths and temperatures. Staminate and pistillat floral initiation occurred in the field during early July suggesting a long-short day flowering response. Mature hydrilla seeds were only observed in Lake Wheeler where seed density ranged from 3-30/sq m in 1984 and 1985. Seed viability ranged from 30% to 5.0% when seeds were collected in January and October 1986 respectively. Seedling vigor was low compared to hydrilla cloned from the parent population. Only one seedling exhibited apparently normal growth. Somatic cells of hydrilla from all North Carolina populations were found to be triploid (3n=24), and this may be the cause for low seed and seedling viability. Study results show the potential for hydrilla dispersal by sexual means in North Carolina is very low and research recommends that effort to manage the plants by minimizing vegetative propagule transportation and using various control methods should continue. (Lambert-UNC, WRRI)
W89-13354

INTERBASIN AND INTRABASIN WATER TRANSFER IN GEORGIA.
Georgia Univ., Athens. Carl Vinson Inst. of Government.
For primary bibliographic entry see Field 6E.
W89-13393

4B. Groundwater Management

MOVEMENT OF VIRUSES AFTER ARTIFICIAL RECHARGE.
Webster (Arthur) Pty Ltd., Baulkham Hills (Australia).
For primary bibliographic entry see Field 5E.
W89-12481

HYDROGEOLOGY OF THE IORI-SHIRAKI ARTESIAN BASIN AND AN OUTLOOK FOR USING ITS UNDERGROUND WATER (GIDROGEOLOGIIA I PERSPEKTIVY ISPOL'ZOVANIIA POZEMNYKH VOD IORI-SHIRAKSKOGO ARTEZIANSKOGO BASSEINA).
For primary bibliographic entry see Field 2F.
W89-12712

POTENTIAL THEORY-BASED FINITE ELEMENT ALGORITHM FOR FRESHWATER RECHARGE OF SALINE AQUIFERS: A SHARP INTERFACE MODEL.
Haryana Agricultural Univ., Hissar (India). Dept. of Soils.
For primary bibliographic entry see Field 2F.
W89-12994

HYDROLOGIC EFFECTS OF INTENSE GROUNDWATER PUMPAGE IN EAST-CENTRAL HILLSBOROUGH COUNTY, FLORIDA, U.S.A.
Southwest Florida Water Management District, Brooksville.
For primary bibliographic entry see Field 6G.
W89-13114

ARTIFICIAL RECHARGE OF GROUNDWATER AND ITS ROLE IN WATER MANAGEMENT.
Geological Survey, Orlando, FL. Water Resources Div.
J. O. Kimrey.
Desalination DSLNAH, Vol. 72, No. 1/2, p 135-147, Apr/May 1989. 12 ref.

Descriptors: *Water management, *Water resources development, *Artificial recharge, *Injection wells, *Groundwater recharge, Water spreading, Overdraft, Water yield improvement, Pumping, Selective withdrawal, Aquifer characteristics, Natural recharge, On-site tests, Economic aspects, Saline water barriers, Persian Gulf.

A key factor to the sustained yield of groundwater is the rate of replenishment of water to the aquifer from which the groundwater is being withdrawn. Artificial recharge occurs when man's activities cause more water to enter an aquifer, either under pumping or non-pumping conditions, than would otherwise enter the aquifer, and can be a practical means of dealing with the problem of overdraft (more water withdrawn than recharged). Methods of artificial recharge are (1) water spreading techniques, and (2) well-injection techniques. Successful use of artificial recharge requires a thorough knowledge of the physical and chemical characteristics of the aquifer system, and extensive on-site experimenting. In general, water spreading techniques are less expensive, and large quantities of water can be handled, and can result in significant improvement in quality of recharge waters. In comparison, well-injection techniques are often used for emplacement of fresh recharge water into saline aquifer zones to form a manageable lens of fresher water, which may later be partially withdrawn for use or continue to be maintained as a barrier against salt-water encroachment. Fresh water occurs only in limited quantities in most of the Arabian Gulf region; also, it is heavily overdrafted in many areas, and receives very little natural recharge. Good use could be made of artificial recharge by well injection in replenishing and managing aquifers in strategic locations if sources of fresh water could be made available for the artificial recharge operations. (Author's abstract)
W89-13145

USE OF MULTIVARIATE MODELING TO ESTIMATE IMPACTS OF GROUNDWATER WITHDRAWALS ON STREAMFLOW FOR THE CAMAS CREEK BASIN.
Idaho Univ., Moscow. Dept. of Civil Engineering.
D. Horn, and S. Jeong.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-204408/AS. Price codes: A12 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, Moscow, Completion Report, May 1989. 242p, 70 fig, 98 tab, 51 ref. Contract 14-08-0001-G1419. Project USGS G1419-08.

Descriptors: *Groundwater, *Multivariate analysis, *Streamflow, *Idaho, *Model studies, Multivariate models, Pumping, Time series analysis, Camas Creek, Selective withdrawal.

The conjunctive use of surface and groundwater has been recognized as posing significant water rights issues in many of the Idaho river basins. Increases in groundwater pumping rates, primarily for irrigation, have led to changes in surface streamflow, affecting previously allocated surface water rights. However, the magnitude of this effect and its variability over time remain difficult to estimate. The primary objective of this study was to develop a multivariate monthly flow model for Camas Creek, based on stream flows in neighboring basins, and to test whether such a model is sensitive enough to detect, at some statistical level of significance, any streamflow changes that may have resulted from groundwater withdrawals. Monthly streamflow records from Camas Creek and three similar neighboring basins were used to develop a multivariate monthly streamflow model of Camas Creek. Model parameters were based on the recorded statistics for the record period common to groundwater development within the Camas Creek basin. The model was developed and tested for its ability to adequately reproduce the historic pre-irrigation time series for Camas Creek. Then the model was applied to the time period in which significant groundwater withdrawals occurred. A comparison of the modeled streamflow with the annual flows for this period was used to estimate the impact of groundwater pumping on monthly, seasonal, and annual streamflows. The differences between the two time series were related to the history of groundwater development within the basin. Although the model appeared to simulate the overall historic time series reasonably well, its performance varied by month and season. The application of the model to the time period in which the Camas Creek basin groundwater withdrawals were significant produced a simulated record with lower streamflows than those observed. This may be attributable to the fact that

most of the large wells have pumped from deep aquifers, with no connection to the surface stream system. (USGS)
W89-13316

HYDROGEOLOGY AND SIMULATED EFFECTS OF GROUNDWATER DEVELOPMENT ON AN UNCONFINED AQUIFER IN THE CLOSED BASIN DIVISION, SAN LUIS VALLEY, COLORADO.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-13339

METHODOLOGY FOR ASSESSMENT OF CONTAMINATION OF THE UNSATURATED ZONE BY LEAKING UNDERGROUND STORAGE TANKS.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W89-13352

STABLE-ISOTOPE INVESTIGATION OF VAPOR TRANSPORT DURING GROUNDWATER RECHARGE IN NEW MEXICO.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W89-13359

USE OF AEROMAGNETIC DATA TO DEFINE BOUNDARIES OF A CARBONATE-ROCK AQUIFER IN EAST-CENTRAL NEVADA.
Geological Survey, Carson City, NV.
For primary bibliographic entry see Field 2F.
W89-13362

MEASUREMENTS OF RECHARGE RATES THROUGH AN UNSATURATED GLACIAL TILL BY TRITIUM ANALYSES.
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 2F.
W89-13381

GROUNDWATER RESOURCES ASSESSMENT OF THE PIEDMONT REGION IN SOUTH CAROLINA.
Clemson Univ., SC. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W89-13407

4C. Effects On Water Of Man's Non-Water Activities

IMPACT OF CATCHMENT URBANISATION ON LAKE MACQUARIE (AUSTRALIA).
State Pollution Control Commission, Lidcombe (Australia).
B. L. Simmons, and S. L. Trengove.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 205-210, 1989. 1 fig, 2 tab, 14 ref.

Descriptors: *Lakes, *Catchment areas, *Wastewater disposal, *Sedimentation, *Eutrophication, *Urbanization, *Recreation, *Tourism, *Water quality, Storm runoff, Urban runoff, Navigable waters, Seagrass, Algae, Lake Macquarie, Australia.

Increasing urbanization of coastal areas is leading to impacts on coastal lakes which decrease their amenity for recreation and tourism. Runoff and wastewater discharge cause siltation, impact seagrass beds and change the characteristics of open waters, affecting boating, swimming, fishing and the aesthetic quality of the locale. Management of urban development and wastewater disposal is required to minimize sedimentation and nutrient enrichment. This could include development restrictions, runoff controls and a strategy for wastewater treatment and discharge. The catchment of Lake Macquarie, a marine coastal lake, has been progressively urbanized since 1945. Urbanization, through increased stormwater runoff and point source discharges, has caused a major impact on the lake in terms of sedimentation and nutrient enrichment. Losses of lake area and navigable waters have occurred. Accompanying problems include change in the distribution of seagrass beds and nuisance growths of benthic algae. Since the 1950's, dry weather nutrient concentrations have increased and mean water clarity has decreased. Severe problems, as observed in other New South Wales coastal lakes, e.g. benthic algae in Lake Illawarra and Tuggerah Lakes, have not yet developed. Because of the lead time taken to implement policies and controls, trends should be identified and policies developed now so as to avoid nutrient buildup and development of sustained problems. (Author's abstract)
W89-12231

ASSESSMENT OF THE IMPACT OF LAND USE ON RECREATIONAL WATERS USING MATHEMATICAL MODELS.
Queensland Dept. of Environment, Conservation and Tourism, Brisbane (Australia). Div. of Water Quality.
J. C. Bennett.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 223-228, 1989. 3 fig, 2 tab, 2 ref.

Descriptors: *Recreation, *Water pollution sources, *Water quality, *Land use, *Land development, *Mathematical models, Long-term planning, Dissolved oxygen, Nitrogen, Phosphorus, Escherichia coli, Pumicestone Passage, Australia.

Mathematical models were used to assist in quantifying the impact of changing land use on the recreational waters of Pumicestone Passage. Runoff, washoff, hydrodynamic and water quality models were first calibrated and then used to predict levels of dissolved oxygen, total nitrogen, total phosphorus and E. coli in the Passage for two future land development scenarios. The models provided valuable tools for understanding the system response to non-point source pollutant loadings and assessing alternative scenarios. They indicated that planned development to the year 2000 would not result in significant water quality deterioration while extreme development is likely to do so to the extent of prejudicing some water uses. (Author's abstract)
W89-12234

NEED FOR THE INTRODUCTION OF A NEW CATEGORY OF 'NATURE RESERVE' IN THE UKRAINE REPUBLIC TERRITORY (O NEOBKHODIMOSTI VVEDNIIA NOVOI KATEGORII ZAPOVEDNOSTI NA TERRITORII UKRAINSKOI SSR).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. I. Merezhko, I. V. Grib, A. K. Iushchenko, and L. I. Frantsevich.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 6, p 3-8, 1988. 2 tab, 11 ref. English summary.

Descriptors: *Watershed management, *Ukraine, *Water conservation, Economic aspects, Public policy.

In order to develop a reserve net in the Ukraine SSR territory it is necessary to make a quantitative leap from the concept of conservation of 'wilderness' objects to elements of effective water resources conservation. This may be realized through the introduction of a new reserve category, the 'state reserve ecological and hydrological regions', connected to river basins which have a significant national economic and conservation value--the Densa and Rossava rivers, the Pripyat River mouth, rivers of the South Crimean Coast, and so forth. This action would permit the necessary reserve optimum while at the same time allowing economic activities to be performed in the catchment areas. (Author's abstract)
W89-12270

SPHAGNUM AND CELLULOSE DECOMPOSITION IN DRAINED AND NATURAL AREAS OF AN ALBERTA PEATLAND.
Alberta Univ., Edmonton. Dept. of Forest Science.
V. J. Lieffers.
Canadian Journal of Soil Science CJSSAR, Vol. 68, No. 4, p 755-761, November 1988. 3 fig, 2 tab, 23 ref.

Descriptors: *Drainage, *Sphagnum, *Cellulose, *Decomposition, *Alberta, *Peat soils, Drainage ditches, Water table, Soil water, Soil science, Temperature.

A 50-ha area of a forested peatland in north central Alberta was drained in 1984. The average water table height 5 m from the drainage ditch was 36 cm lower than in the adjacent natural peatland. This was reflected in lower substrate moisture content at both 10-cm and 30-cm levels in the drained area. Temperatures at 10-cm and 30-cm levels in the drained area peaked at 14.6 and 11.8 C, respectively, compared to 11.7 and 9.2 C in the natural site. In both the drained and natural areas, loss of mass of cellulose and Sphagnum samples from nylon mesh bags after 1 yr was high compared to reported studies. The drained area had greater reduction in mass than the natural site for both cellulose and Sphagnum at the 30-cm levels. The differences were largest for cellulose where loss was 80.8% in the drained peatland compared to 48.6% in the natural site. While this study compares cellulose and Sphagnum loss between drained and undrained peat from only one peatland, it does suggest a large increase in decomposition at deeper strata following drainage. In years of normal or above-average precipitation, the surface rates of decomposition might also be faster in drained sites relative to natural peatlands. The type and mass of litter and organic matter will also change following drainage. (Author's abstract)
W89-12452

BACTERIOLOGICAL WATER QUALITY OF A MULTI-USE CATCHMENT BASIN ON THE AVALON PENINSULA, NEWFOUNDLAND.
Memorial Univ. of Newfoundland, St. John's. Dept. of Biology.
G. I. M. Cowan, E. M. Baggs, and B. T. Hollohan.
Water Research WATRAG, Vol. 23, No. 3, p 261-266, March 1989. 1 fig, 4 tab, 20 ref. President's Fund Memorial University of Newfoundland Grant.

Descriptors: *Aquatic bacteria, *Water quality, *Multipurpose projects, *Water pollution sources, *Newfoundland, *Coliforms, *Drainage systems, *Land use, Precipitation, Hydrogen ion concentration, Surface drainage, Surface-groundwater relations, Seasonal variation, Canada, Geologic control, Physiographic balance.

Baseline investigations of coliform bacterial populations in the Topsail-Manuals drainage system (a multiple land-use system) on the Avalon Peninsula, Newfoundland, Canada, reveal several aquatic regions which are indicative of land usage. Seasonal fluctuations in population numbers were observed in all sample sites and appear to be related to such physical parameters as precipitation and pH. Total coliform numbers were found to be positively correlated with surface land flushing as were fecal coliform numbers but to a lesser extent. Coliform counts appeared to be most influenced by the geology and physiography of the area as well as by land occupancy and usage. (Author's abstract)
W89-12477

URBAN RUNOFF AND COMBINED SEWER OVERFLOW.
Calocerinos and Spina, Liverpool, NY.
For primary bibliographic entry see Field 5B.
W89-12518

IMPACT OF LAND USE AND NPS LOADS ON LAKE QUALITY.
Wray and Todd Interests Ltd., Houston, TX.
D. A. Todd, P. B. Bedient, J. F. Haasbeek, and J. Noell.

Journal of Environmental Engineering (ASCE) JOEEDR, Vol. 115, No. 3, p 633-649, June 1989. 8 fig, 5 tab, 35 ref.

Descriptors: *Lakes, *Water quality, *Land use, *Environmental effects, *Nonpoint pollution sources, *Suspended solids, Watersheds, Catchment areas, History, Phosphorus, Computer models, Model studies, Environmental policy, Irrigation practices, Hydraulic properties.

Extensive land use, nonpoint source (NPS), and lake water quality data were used to determine the interaction of lake water quality and watershed development in the Lake Austin watershed. Historical trends in total suspended solids and total phosphorus were examined over the 1979-84 period, during which impervious cover increased by 79% in the lake watershed. A PC-based continuous stirred tank reactor (CSTR) model was used to depict the response of lake water quality to loadings associated with a variety of development options ranging from impervious cover of 10-40%. The reliability of the model is supported by the unusually simple lake hydraulics, exclusive NPS loading, and extensive data base. Model results led to recommendations that should protect the water quality of the lake. It is recommended that community education and local regulatory programs emphasize impervious cover limits in the range of 30-40%, controls on erosion from construction sites and crop fields, and careful scheduling and location of earthmoving, irrigation, and fertilization. (Friedmann-PTT)
W89-12621

PEAT FIRE IN THE OKAVANGO DELTA, BOTSWANA, AND ITS IMPORTANCE AS AN ECOSYSTEM PROCESS.
University of the Witwatersrand, Johannesburg (South Africa).
For primary bibliographic entry see Field 2H.
W89-12663

CHANGES IN SOIL WATER REGIME AFTER PIPELINE CONSTRUCTION IN SOLONETZIC MIXED PRAIRIE RANGELAND.
Alberta Univ., Edmonton. Dept. of Plant Science.
N. A. Naeth, D. S. Chanasyk, W. B. McGill, A. W. Bailey, and R. T. Hardin.
Canadian Journal of Soil Science CJSSAR, Vol. 68, No. 3, p 603-610, August 1988. 5 fig, 21 ref.

Descriptors: *Soil water, *Environmental effects, *Pipelines, *Soil water potential, Ecological effects, Range management, Ponding, Berms, Canada, Prairies.

A study was conducted in the Solonetzic mixed prairie rangeland of southern Alberta to evaluate soil water responses to pipeline construction. Five adjacent natural gas pipelines on a series of rights-of-way were studied at three sites. The pipelines were installed in 1957, 1963, 1968, 1972 and 1981. Soil water contents were monitored throughout the year using a neutron probe. Water-holding capacity of the soil was determined using the pressure-plate extraction method. Pipeline construction in Solonetzic mixed prairie ecosystems caused total soil water to a depth of 50 cm in the trench to increase over that in the undisturbed prairie. There were no significant effects on available water capacity. Berm construction over the trench impeded overland flow, particularly during springmelt, causing short periods of ponding. Construction activity had no significant effect on total water within zones of a given right-of-way. Soil water status was affected for a short period of time with a trend towards predisturbance conditions within 10 yr. (Author's abstract)
W89-12832

EFFECTS OF LAND USE ON THE WATER QUALITY AND BIOTA OF THREE STREAMS IN THE PIEDMONT PROVINCE OF NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-13013

EVALUATION OF NORTH CAROLINA'S ESTUARINE SHORELINE AREA OF ENVIRONMENTAL CONCERN FROM A WATER QUALITY PERSPECTIVE.
East Carolina Univ., Greenville, NC. Dept. of Geography and Planning.
For primary bibliographic entry see Field 5G.
W89-13047

AQUACULTURE AND COASTAL ZONE MANAGEMENT IN BANGLADESH.
Universidad de Oriente, Cumana (Venezuela). Inst. Oceanografico.
For primary bibliographic entry see Field 8I.
W89-13048

HYDRODYNAMIC ANALYSIS OF FLOODS IN URBAN SYSTEM.
Universidade Federal do Rio Grande do Sul, Porto Alegre (Brazil).
For primary bibliographic entry see Field 2E.
W89-13131

SYNCHRONOUS POLLEN CHANGES AND TRADITIONAL LAND USE IN SOUTH FINLAND, STUDIED FROM THREE ADJACENT SITES: A LAKE, A BOG AND A FOREST SOIL.
Oulu Univ. (Finland).
For primary bibliographic entry see Field 2H.
W89-13303

WELL DATA, SURFACE-WATER DISCHARGE, AND NITRATE CONCENTRATIONS, FEBRUARY 1986–SEPTEMBER 1987, IN PARTS OF THE PASCO BASIN, WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.
B. W. Drost, K. M. Schurr, G. P. Ruppert, and S. E. Cox.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-38, 1989. 132p, 4 fig, 4 tab, 2 ref.

Descriptors: *Water quality, *Water pollution sources, *Dam effects, *Well data, *Nitrates, *Pasco Basin, *Washington, *Water level, *Pesticides, *Groundwater pollution, Sampling, Monitoring.

The U.S. Geological Survey, in cooperation with the State of Washington Department of Ecology, is conducting a study of parts of the Pasco basin, Washington, to determine: (1) effects of dams, surface-water application, canal seepage, and pumpage on groundwater levels; (2) quality of groundwater and probable sources of large concentrations of nitrate; (3) presence of pesticides in the groundwater systems; (4) directions and general rates of movement of undesirable chemicals and/or chemical concentrations in the groundwater system; and (5) possible results of various management alternatives for dealing with high groundwater levels and large concentrations of nitrate in groundwater. This report contains basic data collected from the start of the project in February 1986 through September 1987. The groundwater level network consisted of about 500 wells that were measured in February 1986, September 1986, and February 1987. Water levels were measured monthly in about 70 wells, and 5 wells were monitored with continuous recorders. Groundwater and surface water samples were collected and analyzed for nitrate concentrations and specific conductance. Most of the water level network wells and selected surface-water sites were sampled in September 1986. Selected wells were sampled periodically from September 1986 through September 1987. (USGS)
W89-13340

GROUNDWATER QUALITY IN DOUGLAS COUNTY, WESTERN NEVADA.
Geological Survey, Carson City, NV.
For primary bibliographic entry see Field 2F.
W89-13364

INFLUENCE OF DISCHARGE AND URBANIZATION ON THE CONCENTRATION, SPECIATION, AND BIOAVAILABILITY OF TRACE METALS IN THE RARITAN RIVER, NEW JERSEY.
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5B.
W89-13402

4D. Watershed Protection

ECOLOGICAL PROBLEMS IN CONNECTION WITH SMALL RIVERS (EKOLOGICHESKIE PROBLEMY EKSPLUATATSII MALYKH REK).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 4A.
W89-12265

EVALUATION OF THE STABILITY OF A CHANNEL WITH PARTIAL REVETMENT.
M. Y. Krupnik, and Y. A. Ibad-Zade.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 7, p 409-413, January 1989. 4 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 7, p 31-33, July 1988.

Descriptors: *Retaining walls, *Channel morphology, *Banks, *Channel scour, *Hydraulic design, Hydraulic engineering, Computer models, Flow characteristics, River mechanics, Canal linings.

Partial revetment of the channel of rivers and canals, changing the velocity field of the flow, can cause deformation of the unrevetted part of the channel. In this case, the stability both of the structures on the bank and of the revetment itself is disturbed. A prediction of the deformation of the unrevetted part of a channel with a revetment or an estimation of the stable state of a channel is determined by the solution of a functional equation. To solve the prescribed problem, a special software package was compiled, providing for the solution of four types of problems: (1) deformations of a straight channel with partial revetment of one of the banks; (2) deformations in the channel on a bend without revetment or determination of the stable cross-section of the channel on the bend; (3) deformations in the channel on the bend with revetment of the convex bank; or (4) deformations in the channel on the bend with revetment of the concave bank. Laboratory experiments and on-site investigations were conducted for checking the method described. The differences between the predicted cross-sections and the measured ones are insignificant. This gives grounds to consider the developed method of evaluating deformations of channels with partial revetment and on a bend to be acceptable for design calculations. These ideas can be transferred practically to all problems of hydraulic engineering related to the problem of interaction of a flow and an unrevetted channel, when solving problems of determining the depth of the scour pocket in the lower pool of dams, problems of the parameters of a tortuous channel, etc. (Fish-PTT)
W89-12466

EROSION CONTROL STRATEGIES FOR BAY AND ESTUARINE BEACHES.
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
K. F. Nordstrom.
Coastal Management CZMJBF, Vol. 17, No. 1, p 25-35, 1989. 46 ref.

Descriptors: *Erosion control, *Estuaries, *Coastal zone management, *Bays, *Beach erosion, Wave action, Longshore currents, Sedimentation, Storms, Ocean waves, Shore protection, Recreation demand.

Erosion of bay and estuarine beaches is a widespread problem in the United States. Waves on these beaches are low and have short periods, and rates of longshore sediment transport are low. Erosion rates are high because of the lack of a mecha-

nism for sediment deposition between storms and because there is little sediment on bay shorelines to replenish losses. Bay beaches are lower, narrower, and have a different appearance from ocean beaches, and they provide an alternative for human use. Static shore protection structures are a more viable solution on developed bay beaches than on ocean beaches. Beach nourishment has great value where recreation demand is high. Strategies can be developed to enhance values that are complementary and supplementary to those provided by ocean beaches, but these strategies should be designed specifically for a bayside location. (Author's abstract)
W89-12496

COASTAL ZONE DEVELOPMENT, UTILIZATION, LEGISLATION, AND MANAGEMENT IN CHINA.
China Inst. for Marine Development Strategy, Beijing.
C. Degong.
Coastal Management CZMJBF, Vol. 17, No. 1, p 55-62, 1989. 1 fig, 1 tab.

Descriptors: *China, *Coastal zone management, *Legal aspects, *Shore protection, *Resources development, Tropic zone, Subtropic zone, Temperate zone, Shore protection, Fishing, Coastal waters, Natural resources, Environmental protection, Legislation, Comprehensive planning.

China is a coastal state with 18,000 kilometers of continental shoreline and 14,000 kilometers of island shoreline, with over 5,000 islands. It has one of the longest national shorelines in the world. The coastal zone in China spans three climate zones–tropical, subtropical, and temperate–and the coast is classified as rocky, sandy and gravel, muddy and silty, coral reef, and mangrove. From an administrative standpoint, the coastal zone is situated in nine provinces, an autonomous region, and two municipalities. Although it occupies only about 15 percent of the country's area, it holds about 44 percent of the population. The coastal economy is relatively more developed than in other areas. China has given priority to the development and management of the coastal zone with a three-stage project. The first stage is comprehensive investigation to formulate a long-term program for development and utilization in the coastal area. The second stage is investigation at selected locations for development measures to improve reclaimed salty soil, strengthen marine fishing measures, develop seawater culture, establish a forest protection system, prevent coastal erosion, regulate the transport routes, and establish natural resources and environmental protection areas. The third stage is to draft legislation and management measures for the coastal zone. Tentative national management regulations on the coastal zone in Jiangsu Province have already been adopted. (Author's abstract)
W89-12497

SCALE MODEL OF THE 'RIVIERE DES GALETS' (REUNION ISLAND) (MODELE REDUIT PHYSIQUE DE LA RIVIERE DES GALETS (LA REUNION)).
For primary bibliographic entry see Field 2J.
W89-12883

SEDIMENTS IN THE ARVE TORRENTS: FUNCTIONAL DISCONTINUITIES AND IMPACTS OF IMPROVEMENT WORKS ON WATERSHEDS (LES SEDIMENTS DANS LES TORRENTS DE L'ARVE: DISCONTINUITE FONCTIONNELLE ET IMPACTS DE L'AMENAGEMENT DES BASSINS VERSANTS).
Lyon-3 Univ. (France). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W89-12884

CONSEQUENCES OF THE DEGRADATION OF ARVE RIVER ON ITS BANKS AND ON BRIDGES AND OTHER WORKS: COMPREHENSIVE STUDY OF THE SEDIMENT TRANSPORT ALONG ITS COURSE (CONSEQUENCES DE L'ENFONGEMENT DU LIT DE L'ARVE SUR LES BERGES ET LES OUVRAGES: BILAN GENERAL DES TRANSPORTS SOLIDES SUR LE COURS D'EAU).
For primary bibliographic entry see Field 2J.
W89-12886

TRANPSORT OF SOLIDS OF THE RIVER ARVE INTO THE GENEVA'S RHONE (LES APPORTS SOLIDES DE L'ARVE DANS LE RHONE GENEVOIS).
For primary bibliographic entry see Field 2J.
W89-12896

UPPER RHONE FLUSHES–REMARKS ON THE ACTIVITIES OF 1987 (LES CHASSES FRANCO-SUISSES SUR LE HAUNT-REFLEXIONS SUR LES OPERATIONS DE 1987).
Compagnie Nationale du Rhone, Lyon (France).
For primary bibliographic entry see Field 2J.
W89-12897

EROSION-BASED LAND CLASSIFICATION SYSTEM FOR MILITARY INSTALLATIONS.
Construction Engineering Research Lab. (Army), Champaign, IL.
For primary bibliographic entry see Field 2J.
W89-13018

STUDY OF RAINFALL SIMULATORS, RUNOFF AND EROSION PROCESSES, AND NUTRIENTS YIELDS ON SELECTED SITES IN ARIZONA AND NEW MEXICO.
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W89-13321

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

ANALYTICAL CHEMISTRY OF ORGANIC COMPOUNDS PRESENT IN WATER.
Ames Lab., IA.
G. A. Junk.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 23-30, 1989. 1 tab, 3 ref. U.S. Department of Energy contract W-7405-Eng-82.

Descriptors: *Chemical analysis, *Pollutant identification, *Water analysis, *Organic compounds, *Trace levels, *Gas chromatography, *Mass spectrometry, Reviews, Organotin compounds, Pesticides, Dioxins, Polychlorinated biphenyls, Hydrocarbons.

Trace organic analysis is reviewed as it relates to the contamination of water. Included are discussions of the history of the determination of trace levels of organic compounds and the important instruments currently used to make these determinations (gas chromatography and mass spectrometry). Data from three past studies of water pollution are used to provide a better perspective of the possible effects of water contamination: (1) organotin compounds in oceans; (2) pesticides in rivers and lakes; and (3) dioxins, PCBs and PAHs. Future research should investigate methods for determining polar and higher molecular weight (> 400) compounds, that accounted for 90% of the unidentified compounds in most waters. Solvent extraction is expected to be almost totally replaced by solid phase extraction. (Sand-PTT)
W89-12205

BACTERIOLOGICAL QUALITY OF TIDAL BATHING WATERS IN SYDNEY (AUSTRALIA).
New South Wales Dept. of Health, Lidcombe (Australia). Div. of Analytical Labs.
For primary bibliographic entry see Field 5B.
W89-12211

UREASE AS A POSSIBLE TRACER FOR SEWAGE EFFLUENT PLUMES.
Queensland Dept. of Environment, Conservation and Tourism, Brisbane (Australia). Div. of Water Quality.
R. Sadler.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 93-97, 1989. 2 fig, 2 tab, 7 ref.

Descriptors: *Tracers, *Path of pollutants, *Water pollution sources, *Environmental tracers, *Enzymes, *Sewage bacteria, *Plumes, Wastewater disposal, Escherichia coli, Sediments, Bacterial analysis, Tracers.

The suitability of sedimentary urease activity as a potential tracer for sewage outfall plumes was examined. Enzyme activity is readily measured in the sediments by a relatively simple procedure and results may be obtained within a few hours of sampling. The results of urease measurements in areas around point source discharges were compared with bacteriological data for the same areas. Three areas were selected for study: a discharge of untreated sewage into a harbor, a discharge from a sewage treatment plant to a river and a discharge from a contaminated drain to a small beach. In all cases, positive correlation between the distribution of the two parameters was observed. Urease activity probably reflects the movement of soluble products from the outfall whereas E. coli represents the particulate phase of the discharge. Although further work will be required, urease activity does offer a potential alternative to E. coli for tracing plumes of fecal pollution. (Author's abstract)
W89-12215

BIOCHEMICAL OXYGEN DEMAND BY A SIMPLIFIED PROCEDURE.
Simmonds and Bristow Pty Ltd., Yeronga (Australia).
J. L. Bristow.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 177-182, 1989. 4 tab, 2 ref.

Descriptors: *Biochemical oxygen demand, *Wastewater analysis, Comparison studies, Laboratory procedures, Analytical methods.

Comparative tests made in 1979 and 1980 have shown that the Klein & Gibbs mathematical calculation of BOD5 can give equivalent results to those obtained using the APHA Standard Method 16th Edition Section 507. This method corrects for dilution water blank and seed. It can give just as consistent results as the Standard Method. Both methods can be inaccurate when interfering substances are present. Aging of dilution water and aeration of samples with less than 5 mg/L dissolved oxygen have improved the consistency of the results. Halving of the incubation volume has had no effect on the accuracy of the results. (Author's abstract)
W89-12226

USE OF WATER TEST-ORGANISMS IN WASTE-DERIVED ALUMINUM SULFATE TOXICITY STUDIES IN VIEW OF ITS UTILIZATION AS A COAGULANT IN WASTE WATER TREATMENT (IZPALZVANE HA VODNI TEST-OBEKTI PRI ISLEDRANE TOKSICHNOSTTA NA ALUMIMEV SULFAT, POLYCHEN OT OTPAD CHNI PRODUKTI, S OGLED PRILAGANETO MI KATO KOAGULANT PRIPRECHISTVANE HA OTPAD' RDNI VODI(IN BULGARIAN).
Napravlenie Nauchno-Tekhnologihni Izsledvaniia Pri Kompleksniia Nauchno-Izsledovatelski i Proektantski Institut po Blagoustroistva i Komunalno Stopanstvo, 1618 Sofia (Bulgaria).
V. Semov, V. D. Donchev, and C. J. Popov.
Hydrobiologia HYDRB8, Vol. 24, p 63-70, 1985. 3 fig, 2 tab, 7 ref. English summary.

Descriptors: *Water pollution effects, *Bioindicators, *Bulgaria, *Wastewater treatment, *Coagulation, *Toxicity, *Water treatment, Fish, Crustaceans, Daphnia, Aluminum sulfate, Sulfates, Kaolin.

The toxicity to water organisms of Al2(SO4)3 obtained from kaolin and waste H2SO4 was studied. Saprophytic water microflora, lower crustaceans (Daphnia magna) and fish (Lebistes reticulatus) were used in the study. Natural, pollutant-free water was coagulated at doses of 250 to 2000 mg/cu dm waste-derived Al2(SO4)3. Common Al2(SO4)3 was used in the control test. The tested coagulant showed no inhibiting or bacteriostatic effect on the natural microflora involved in the initial self-purification of water. It did not show significantly higher acute toxicity to the crustaceans as compared to the control substance. No mortality was observed in the fish test. The results showed that the waste-derived coagulant containing 2,4-dinitrotoluol and 2-and 3-nitrobenzenic acid at concentrations of 0.2 to 0.3% can be used in water purification. (Author's abstract)
W89-12260

CHARACTERISTICS OF GROUNDWATERS IN THE L. I. BREZNEV METALLURGICAL WORKS, BASED ON MICROBIOLOGICAL INDICES (KHARAKTERISTIKA NA GRUNTOVITE VODI OT RAIONA NA SMK ' L.I. BREZHNEV' VIZ OSNOVA NA MIKROBIOLOGICHUI POKAZATELI) (IN BULGARIAN).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 5B.
W89-12264

CORRECT USE OF MEMBRANE NITROCELLULOSE FILTERS IN WATER MICROBIOLOGY (O KORREKTNOSTI ISPOL'ZOVANIIA MEMBRANNYKH NITROTSELLIULOZNYKH FIL'TROV V VODNOI MIKROBIOLOGII).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. A. Potanova, A. P. Potanov, and T. V. Korolevskaia.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 6, p 73-78, 1988. 3 fig, 1 tab, 17 ref. English summary.

Descriptors: *Pollutant identification, *Bacterial analysis, *Filters, *Membrane filters, Nitrocellulose, Microbiological studies, Water analysis.

It is shown that nitrocellulose membrane filters retain bacteria not only mechanically but also by sorption. The dependence of the number of the retained bacteria on the volume of the filtered water (under a constant concentration of bacteria) is shown to be nonlinear, in spite of the accepted theories. This points to the necessity of revising the accepted method for calculating the concentration of bacteria in water. (Author's abstract)
W89-12278

MEXICAN ROTIFERS AS INDICATORS OF WATER QUALITY WITH DESCRIPTION OF COLLETHECA RIVERAI, N.SP.
Universidad Nacional Autonoma de Mexico, Mexico City. Escuela Nacional de Estudios Profesionales Iztacala.
G. Vilaclara, and V. Sladecek.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 2, p 257-263, April 1989. 2 fig, 1 tab, 17 ref.

Descriptors: *Bioindicators, *Rotifers, *Water quality, *Taxonomy, *Mexico, *Systematics, Saprobic index, Ponds, Lakes, Reservoirs, Callotheca riverai, New species.

The Rotifer fauna of some standing water bodies in and around Mexico City was studied in relation to water quality. A list of species found was supplemented with the quantitative data of saprobic valence, indicative weight of species and individual saprobic index. Collotheca riverai from the Reservoir Valle de Bravo was described as new for science. Because the subtropical climate in Mexico is compensated by the high altitude, the rotifers on Altiplanicio Central show the same saprobiological characteristics as in Central Europe. (Author's abstract)
W89-12291

SPECTROCHEMICAL DETERMINATION OF METALLIC POLLUTANTS AT SUB PPM LEVELS IN FRESH WATER SAMPLES.
Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.
R. Venkatasubramanian, and N. P. Karanjikar.
Analytical Letters ANALBP, Vol. 22, No. 4, p 981-987, April 1989.

Descriptors: *Spectrometers, *Pollutant identification, *Water analysis, *Trace elements, *Heavy metals, Cadmium, Cromium, Iron, Manganese, Nickel, Lead, Zinc, Water pollution, Detection limits.

A quantitative method to analyze freshwater samples for ultratrace pollutants such as Cd, Cr, Fe, Mn, Ni, Pb, V and Zn was developed. The impurities in the water sample were preconcentrated by the method of slow evaporation and collected on specpure graphite that was subsequently analyzed by d.c. arc excitation using NaF as the carrier. The mean relative standard deviation of the method employed is +or-15%. The accuracy of the method has been found to be quite satisfactory as shown by the results of the Intercomparison Run conducted by the International Atomic Energy Agency, Vienna, for the determination of trace elements in water. The detection limits for the various elements were shown to be as follows: Ni, Pb, V: 1 ng/ml; Cd, Cr, Mn: 2 ng/ml; Fe: 15 ng/ml, and Zn: 20 ng/ml. Some of these detection limits have been compared with those obtained in some of the recent techniques such as AAS, Laser Induced Fluorescence, (LIF) and Laser Enhanced Ionization (LEI) or Opto-Galvanic Spectrometry (OGS). There is a tenfold increase in sensitivity for Pb in this method as compared to the LIF, AAS and OGS techniques, while the detection limits obtained for other elements are comparable with those in the other technique. (Author's abstract)
W89-12355

IMPROVED METHOD FOR THE CONCENTRATION OF ROTAVIRUSES FROM LARGE VOLUMES OF WATER.
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
G. A. Toranzos, and C. P. Gerba.
Journal of Virological Methods VMEDH, Vol. 24, No. 1/2, p 131-140, 1989. 3 tab, 30 ref.

Descriptors: *Viruses, *Rotaviruses, *Pollutant identification, *Water analysis, *Filtration, Pollutants, Pathogens.

A microporous filter method for the concentration and reconcentration of rotaviruses from large volumes of water was developed. The method allows for the processing of large volumes of water with high recoveries of rotaviruses. Averages of 49% and 41% of seeded viruses were recovered from 20 and 400 L of water, respectively. Of the various eluents evaluated, a mixture of 10% tryptose phosphate broth and 3% beef extract at a pH value of 10.0 gave the greatest elution efficiency. The use of the positively charged 1MDS filters allowed for the processing of waters without the need for pH adjustments. An overall recovery of 35% was obtained from 400 L when hydroextraction was used as a second-step concentration procedure. (Author's abstract)
W89-12374

CONTINUOUS FLOW METHOD FOR SIMULTANEOUS DETERMINATION OF MONOCHLORAMINE, DICHLORAMINE, AND FREE CHLORINE: APPLICATION TO A WATER PURIFICATION PLANT.
Osaka Prefectural Univ., Sakai (Japan). Lab. of Environmental Chemistry.
T. Aoki.
Environmental Science and Technology ESTHAG, Vol. 23, No. 1, p 46-50, January 1989. 9 fig, 2 tab, 22 ref.

Descriptors: *Water analysis, *Pollutant identification, *Water treatment, *Chemical analysis, *Chlorine, Separation techniques, Chlorinated hydrocarbons, Disinfection, Amino acids, Ammonia, Decomposition, Chemical reactions.

A system with three double-tube separation units, each with an inner tube of microporous PTFE and an outer tube of PTFE, is proposed for the continuous, simultaneous determination of monochloramine, dichloramine, and free chlorine in water. The quantitative reaction between chloramines and iodide was used in order to quantify conveniently the chlorine species as available chlorine. Chloramines and chlorine above 0.1 mg of Cl2/L can be determined by the present method. Inorganic chloramines (ammonia derived) and chloroamino acids (amino acid derived) can also be distinguished by the present method. From the application of this method at a water purification plant, the dynamic behavior of chloramines and free chlorine has become apparent. Dichloramine is degraded appreciably by sunlight; it decomposes to produce slight amounts of free chlorine in the course of purification. (Author's abstract)
W89-12379

CHARACTERIZATION OF ORGANIC MATERIAL LEACHED FROM COAL BY SIMULATED RAINFALL.
Maryland Univ., Solomons. Chesapeake Biological Lab.
N. J. Fendinger, J. C. Radway, J. H. Tuttle, and J. C. Means.
Environmental Science and Technology ESTHAG, Vol. 23, No. 2, p 170-177, February 1989. 1 fig, 7 tab, 20 ref.

Descriptors: *Organic matter, *Leachates, *Simulated rainfall, *Coal, *Weathering, Pennsylvania, Maryland, Acidity, Conductivity, Suspended solids, Hydrocarbons, Chlorinated hydrocarbons, Aromatic compounds.

This report describes the leaching characteristics of several widely utilized eastern coals, assesses the potential environmental impact of organic material leached from coal, and relates the organic content of leachates to the chemical characteristics of the source coals. Laboratory leaching experiments were conducted using coals collected from the Upper, Middle, and Lower Kittaning seams in Pennsylvania and from an unspecified seam in western Maryland. Leachates were characterized by low pH (1.67-3.22), high conductivities (3300-24000 micromhos), and high concentrations of suspended material (322-3300 mg/L). Dichloromethane extracts of the soluble and particle fractions of the leachates contained complex mixtures of aliphatic and aromatic hydrocarbons including alkyl-substituted and normal polynuclear aromatic hydrocarbons. Highest concentrations of aromatic compounds were measured in leachates from coals with the highest solvent-extractable aromatic hydrocarbon content. Comparison of results from laboratory leaching chambers with selected chemical characteristics of leachates collected at a coal storage site suggested that weathering processes occurring in environmental situations can be approximated by laboratory experiments. (Author's abstract)
W89-12386

DETERMINATION OF PRACTICAL QUANTITATION LEVELS FOR ORGANIC COMPOUNDS IN DRINKING WATER.
American Water Works Association Research Foundation, Denver, CO.
J. L. Oxenford, L. J. McGeorge, and S. W. Jenniss.
Journal of the American Water Works Association JAWWA5, Vol. 81, No. 4, p 149-154, April 1989. 9 tab, 8 ref, append.

Descriptors: *Water quality standards, *Organic compounds, *Drinking water, *Detection limits, *Chemical analysis, New Jersey, Benzenes, Chlorinated hydrocarbons, Gas chromatography, Mass spectrometry, Groundwater, Surface water, Organic carbon.

This article describes the approach used by the state of New Jersey to determine practical quantitation levels (PQLs) for 22 organic compounds in drinking water. An interlaboratory study was conducted using six state-certified laboratories. Sam-

ples with concentrations ranging from 0.1 to 20 micrograms/L were analyzed using EPA methods 502.1, 503,1, and 524.1. Results indicated a clear decrease in precision and accuracy with decreasing concentration. Acceptable quantitation could be achieved between 1 and 5 micrograms/L for volatile organic contaminants. The PQLs were affected by the individual analyte's performance in the methods. Development of the PQLs should therefore be analyte-specific, with the resultant values dependent on the method's performance in detecting that particular analyte. Since this study, the 500-series methods have undergone major revisions. Methods 502.1 and 503.1 can no longer be performed in series. Capillary columns are now allowed and are being used in methods 502.2 and 524.2. These changes will most likely improve the analyses of low-level samples. Although the methods have been modified, the approach described here is still useful for determining the PQL. Because PQLs are method-specific, they must be updated as the methods change. (Author's abstract)
W89-12393

GILL ATPASE ACTIVITY IN PROCAMBARUS CLARKII AS AN INDICATOR OF HEAVY METAL POLLUTION.
Valencia Univ. (Spain). Dept. of Animal Physiology.
A. Torreblanca, J. Del Ramo, and J. Diaz-Mayans.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 6, p 829-834, June 1989. 3 tab, 16 ref.

Descriptors: *Adenosine triphosphate, *Pollutant identification, *Gills, *Enzymes, *Crayfish, *Bioindicators, *Heavy metals, Crustaceans, Water pollution, Bioaccumulation, Analysis of variance, Sodium, Potassium, Magnesium, Animal physiology, Spain, Sublethal effects.

Crayfish (Procambarus clarkii) were collected from Lake Albufera (Valencia, Spain) to determine the relation between crayfish gill ATPase activity changes and metal exposure in the laboratory. The Na,K-ATPase activity in gill tissue went up as the exposure time increased. On the contrary, the Mg-ATPase activity in the same tissue showed no statistically significant tendency to decrease with exposure period increasing. The total-ATPase activity after 96-h exposure decreased with respect to the controls. However, significant differences were not found when the values were analyzed by the ANOVA test ($p > 0.05$). Results indicate an unclear effect of cadmium on ATPase activities in the gill of P. clarkii. In relation to mercury effect, these findings would agree with other authors. No significant effect of sublethal concentrations of this metal on ATPase activity in the gill of P. clarkii has been found. On the basis of the results given in this work and that obtained by other authors, the ATPase activities do not seem valuable parameters in the determination of the physiological damage caused by the heavy metal treatment at sublethal concentrations when this enzymatic activity is the only indicator utilized. (Author's abstract)
W89-12444

RAPID TOXICITY ASSESSMENT OF WATER-SOLUBLE AND WATER-INSOLUBLE CHEMICALS USING A MODIFIED AGAR PLATE METHOD.
National Water Research Inst., Burlington (Ontario). Shore Processes Section.
D. Liu, Y. K. Chau, and B. J. Dutka.
Water Research WATRAG, Vol. 23, No. 3, p 333-339, March 1989. 3 fig, 5 tab, 18 ref.

Descriptors: *Culturing techniques, *Pollutant identification, *Toxicity, *Bioassay, Agars, Solvents, Culture media, Solubility, Organic compounds, Inorganic compounds, Metals, Structure-activity relationships.

Use of a direct agar diffusion assay presents a simple, rapid, and sensitive technique for determining the chemical toxicity of both water-soluble and -insoluble compounds. The procedure involves the use of an effective, yet non-toxic, carrier solvent system to dissolve the test chemicals and a 30-degree-Centigrade incubation temperature to accelerate bacterial growth on the seeded agar plate. Under optimum conditions, test results are obtainable within a three-to four-hour time frame instead of the 18-to 48-hour incubation required by conventional agar plate methods. Twenty-nine chemical compounds (15 organics, 10 inorganics, 4 organometallics), representing a wide range of environmental contaminants, have been evaluated for their toxicity by the present procedure. The toxicity of the test chemicals could be easily demonstrated at concentrations as low as 0.1 micrograms per spot on the agar plate. A linear relationship between the test toxicant concentration (micrograms per spot) and the diameter (millimeters) of the clear inhibition zone on the agar plates was also observed. This indicates that the procedure is a convenient and economical tool in quantitative toxicological studies of chemical compounds. The proposed method appears to be suitable for both toxicity screening and structure-activity studies. (Author's abstract)
W89-12486

INORGANICS.
Massachusetts Univ., Amherst. Graduate School.
M. E. De Cheke.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 727-755, June 1989. 10 tab, 551 ref.

Descriptors: *Water analysis, *Chemical analysis, *Literature review, *Inorganic compounds, *Sample preparation, *Chromatography, *Spectroscopy, *Electrochemistry, Atomic absorption spectroscopy, Emission Spectroscopy, Ion chromatography, Gas chromatography, Flow injection, Voltometry, Neutron activation, X-ray fluorescence.

The major accomplishments of 1988 in the field of inorganic chemical analyses are reviewed. Tables cover: (1) sample preparation; (2) sample preconcentration methods; (3) speciation; (4) chromatographic techniques such as ion chromatography, high performance liquid chromatography, and gas chromatography; (5) spectroscopy techniques such as atomic absorption spectroscopy, inductively coupled plasma, atomic emission spectroscopy, and inductively coupled plasma-mass spectrometry; (6) electrochemical methods such as ion selective electrodes and voltometry; (7) flow injection analysis; (8) other instrumental techniques such as neutron activation and x-ray fluorescence; and (9) classical spectrophotometric techniques. In addition, a table of methods used for individual elements or compounds and some general reviews on sophisticated instrumental methods such as inductively coupled plasma-mass spectrometry (ICP-MS), flow injection analysis (FIA), and high performance liquid chromatography (HPLC) are presented. (White-Reimer-PTT)
W89-12502

ORGANICS.
Tennessee Technological Univ., Cookeville.
M. E. Nubbe, V. D. Adams, R. J. Watts, and Y. R. Clark.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 755-779, June 1989. 9 tab, 305 ref.

Descriptors: *Chemical analysis, *Water analysis, *Wastewater analysis, *Literature review, *Organic compounds, *Chromatography, *Spectroscopy, *Ionization, Gas chromatography, Liquid chromatography, Ultrafiltration, Mass spectrometry, Fluorescence, Nuclear magnetic resonance, Infrared spectroscopy, Biochemical oxygen demand, Chemical oxygen demand, Organic carbon.

A literature review focuses on the determination of organics and on the presence and behavior of organics in the environment, with emphasis on water, environmental samples related to water, municipal and industrial wastewaters, and human-exposure samples. Techniques for the determination of organics depend on the compound or the fraction of interest. The majority of analyses use a solvent extraction, cleanup, and determination by gas chromatography (GC) or high performance liquid chromatography (HPLC). Literature reviews of analytical methods are presented for functional group analysis, thin-layer and paper chromatography, gas chromatography, column liquid chromatography, and mass spectrometry. Literature is summarized on analytical methods or on the presence and behavior of compounds in the environment with tables provided for total organic determinations and surfactants; aliphatic and aromatic hydrocarbons; pesticides, chlorinated hydrocarbons, and related compounds; naturally occurring organics; organics in surface and groundwater, drinking water, and wastewater; and hazardous wastes. Total organic determinations used widely in environmental engineering include: biochemical oxygen demand (BOD); chemical oxygen demand (COD); total organic carbon; and dissolved organic carbon (DOC). Total or dissolved organic halogens (TOX or DOX) are used for the determination of total chlorinated and brominated compounds without speciation. New advances in the area of total organic determinations include graphical methods, thermal lens spectrometry applied to the colorimetric determination of dissolved organic material, molecular weight distribution of adsorbable organic halogens, and biodegradability of complex wastes. (White-Reimer-PTT)
W89-12503

WATER CHARACTERISTICS.
Iowa State Univ., Ames. Dept. of Civil Engineering.
A. D. Levine.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 779-782, June 1989. 48 ref.

Descriptors: *Chemical analysis, *Wastewater analysis, *Water analysis, *Literature review, *Bioassay, *Toxicity, *Monitoring, Hydrogen ion concentration, Turbidity, Alkalinity, Odor, Oxygen demand, Particle characterization, Viruses, Humic compounds, Adenosine triphosphate.

Biological and physical methods of analysis of water and wastewater characteristics are reviewed. Biological analytical techniques include: (1) new and improved procedures for detecting viruses in wastewater; (2) fluorescent techniques to conduct bacteriological studies of activated sludge; (3) measurement of algal concentrations using spectral reflectance, chlorophyll-a, and secchi disk transparency; (4) toxicity assays; (5) evaluation of potential water quality indices; (6) environmental monitoring by immunoassay; (7) the use of nitrification, respiration, and bacteria growth rates to assess wastewater toxicity; and (8) bioassays. The major topics covered are pH, turbidity, alkalinity, odor, oxygen demand, ATP and activity measurements. Measurement techniques for quantifying humic compounds and recent applications of particle characterization in wastewater analysis are also discussed. (White-Reimer-PTT)
W89-12504

CONTINUOUS MONITORING, AUTOMATED ANALYSIS, AND SAMPLING PROCEDURES.
Oak Ridge National Lab., TN. Chemical Technology Div.
For primary bibliographic entry see Field 7B.
W89-12505

AQUATIC SEDIMENTS.
URS Consultants, Inc., Cleveland, OH. Planning and Environmental Services Div.
T. J. Denbow, and W. S. Davis.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 1054-1068, June 1989. 273 ref.

Descriptors: *Pollutant identification, *Literature review, *Sediments, *Sediment-water interfaces, *Dredging effects, *Sediment contamination, Heavy metals, Pesticides, Polychlorinated biphenyls, Bioassay, Toxicity, Nutrients, Radionuclides, Model studies, Organic compounds, Aquatic life, Paleolimnology.

A review of recent research on aquatic sediments includes; (1) A general overview of method and

policy-related documents on mitigation of sediment contamination, metal-sediment interactions, and ecological effects of sediment contamination; (2) Methods for detecting volatile fatty acids, rotenone, hexachlorophane, dioxin, organics, PCBs, PAHs, chlorine, viruses, pesticides, and performing algal assays; (3) Biological activity and toxicity in amphipods, oligochaetes, shrimp, periphyton, polychaetes, mussels, daphnia, eelgrass, fish, shellfish and other organisms; (4) Nutrients; (5) Benthic oxygen flux as a result of wasteloads by means of models, in situ studies, and laboratory methods; (6) Metals; (7) Radionuclides; (8) Organics; (9) Dredging effects; and (10) Modeling and paleolimnology to determine resuspension, deposition, and transport of fine-grained cohesive sediments; chrysophyte and diatom distributions; isotopic composition of oxygen in calcareous tufa; past human disturbance; correlating and relating ages of Quaternary marine sediments in Australia; and mechanical reworking of sediments. (White-Reimer-PTT)
W89-12542

HUMAN HEALTH EFFECTS ASSAYS.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
For primary bibliographic entry see Field 5C.
W89-12544

DETECTION AND OCCURRENCE OF WATERBORNE BACTERIAL AND VIRAL PATHOGENS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
G. D. Boardman, T. R. McBrayer, and P. Kohlhepp.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 1097-1109, June 1989. 184 ref.

Descriptors: *Pollutant identification, *Literature review, *Bacteria, *Viruses, *Pathogens, *Path of pollutants, *Fate of pollutants, *Pathogenic bacteria, Indicator organisms, Testing procedures, Potable water, Aquatic environments, Marine environments, Porous media, Distribution, Persistence.

Recent studies on the detection and occurrence of waterborne bacterial and viral pathogens are reviewed. Detection techniques and/or occurrence and distribution patterns of Aeromonas, Campylobacter and Clostridium, Coliforms, Legionella, Mycobacterium, Salmonella and Shigella, Erwinia and Enterococci, Pragia, Leptospira and Pseudomonas, Vibrio, and Yersinia are discussed. Other topics discussed are: (1) The persistence of bacteria in fresh water, potable waters, marine waters, and porous media; (2) Virus detection using filtration, flocculation and adsorption, immunoassays, and field kits for detection in natural waters; and (3) Virus distribution and occurrence in wastewater, potable waters, recreational environments, patient isolations, and the persistence of viruses and their use as indicator organisms. (White-Reimer-PTT)
W89-12546

BIOMONITORING.
Eckenfelder, Inc., Nashville, TN.
G. Isom.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 1117-1121, June 1989. 37 ref.

Descriptors: *Monitoring, *Literature review, *Bioassay, *Toxicity, *Testing procedures, *Water pollution effects, *Hazardous materials, *Bioindicators, Test organisms, Monitoring, Effluents, Aquatic life.

The working definition of biomonitoring for the purposes of this review of current literature is determination of the toxicity of a chemical or an effluent using plants, fish, or invertebrates utilizing standardized protocols. Biomonitoring also includes toxicity testing of multiple, complex, effluents by instream or ambient monitoring. Topics discussed include: (1) Toxicity test methods for marine and estuarine species for estimating chronic toxicity, an ASTM reference for standards, and biomonitoring approaches for toxicity screening of hazardous waste sites; (2) Standard reference toxicants; (3) The use of plants such as Lemna and algae for toxicity testing; (4) The use of invertebrates and the need for selecting a species that is ecologically relevant; (5) Fish and mixed media studies for monitoring toxicity, evaluating contaminated and uncontaminsted environments, designing mobile laboratory studies, and to measure effects of metals by the use of biochemical changes; (6) Hazardous waste media to determine the response of food plants, algae, fish, and sediment elutriates; (7) Endpoint calculation and data evaluation; (8) Testing and research needs; and (9) Toxicity identification evaluation whereby the physical and chemical characteristics of the constituents in wastewater effluents can be identified, and biomonitoring techniques can be utilized for toxicity fractionation, source analysis, and treatment alternatives. (White-Reimer-PTT)
W89-12548

ANALYTICAL DETERMINATION OF ORTHO-PHOSPHATE IN WATER.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 7B.
W89-12577

CLASSIFICATION AND ORDINATION OF MACROINVERTEBRATE ASSEMBLAGES TO PREDICT STREAM ACIDITY IN UPLAND WALES.
Welsh Water Authority, Bridgend. South Eastern District Lab.
K. R. Wade, S. J. Ormerod, and A. S. Gee.
Hydrobiologia HYDRB8, Vol. 171, No. 1, p 59-78, February 1, 1989. 8 fig, 5 tab, 55 ref.

Descriptors: *Acid rain, *Bioindicators, *Wales, *Acidic water, *Water pollution effects, *Monitoring, *Statistics, *Macroinvertebrates, Prediction, Hydrogen ion concentration, Aluminum, Aquatic insects, Multivariate analysis, Correlation analysis, Statistical methods, TWINSPAN, DECORANA, Computer programs.

Macroinvertebrates were collected from riffles at 104 sites in upland Wales during April and July 1984. Species assemblages were ordinated by DECORANA, classified by TWINSPAN both FORTRAN program and related to stream chemistry and other environmental factors using correlation and multiple discriminant analysis. DECORANA axis 1 was correlated most strongly with pH and aluminum concentration, whereas axis 2 correlated with stream gradient and flow. Four TWINSPAN site groups established in each season also were related principally to pH and aluminum concentration, and reflected overall taxon-richness; differences between groups were most apparent during spring, when catchment forest cover and taxon-richness also were related. A dichotomous key based on indicator species was established for each season with the coleopteran Hydraena gracilis Germar and the Ephemeroptera, including Baetis rhodani Pictet, important indicators at Level 1. It is proposed that these indicator systems may be used for the rapid detection and assessment of acid waters throughout Wales and that the methodology is applicable generally. (Author's abstract)
W89-12596

PRINCIPAL COMPONENT ANALYSIS: A CHEMOMETRIC AID FOR CLASSIFICATION OF POLLUTED AND UNPOLLUTED MUSSELS.
Trieste Univ. (Italy). Dipt. di Economia e Merceologia delle Risorse Naturali e della Produzione.
L. Favretto, L. Gabrielli Favretto, G. Pertoldi Marletta, and M. Saitta.
Analytica Chimica Acta ACACAM, Vol. 220, No. 1, p 135-144, May 1 1989. 2 fig, 6 tab, 21 ref.

Descriptors: *Principal component analysis, *Mytilus, *Chemical analysis, *Tissue analysis, *Water analysis, *Pollutant identification, *Trace elements, *Heavy metals, *Atomic absorption spectrophotometry, Mollusks, Aluminium, Cromium, Manganese, Iron, Cobalt, Nickel, Zinc, Cadmium, Lead, Statistical analysis, Mussels, Classification.

Ten trace elements (Al, Cr, Mn, Fe, Co, Ni, Zn, Cd and Pb) were determined in the dissolved ash of the edible part of wild mussels (28 samples) from a polluted site by electrothermal atomic absorption spectrometry. The distribution of the concentration of each element in the mussels was first investigated by means of a test of normality. The correlation matrix around the mean was used as a starting matrix for principal component analysis (PCA). Ten variables were reduced to two principal components, accounting for 77% of the total variance; Al, Cr, Mn, Fe, Zn, Cd and Pb are all positively associated with the first principal component and form a cluster of variables, indicating a common terrigenous origin. Comparison with 43 samples of unpolluted mussels from a nearby hatchery, on the basis of eight common variables (concentration of Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb; 71 samples) by using a two-dimensional plot of PC scores, allows the mussels from the two sites to be differentiated. (Author's abstract)
W89-12601

TRACE METAL ASSOCIATIONS IN THE WATER COLUMN OF SOUTH SAN FRANCISCO BAY, CALIFORNIA.
Geological Survey, Menlo Park, CA. Water Resources Div.
J. S. Kuwabara, C. C. Y. Chang, J. E. Cloern, T. L. Fries, and J. A. Davis.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 3, p 307-325, March 1989. 6 fig, 4 tab, 79 ref.

Descriptors: *Trace metals, *California, *Estuaries, *Pollutant identification, *Trace elements, *Heavy metals, *San Francisco Bay, *Dissolved solids, Organic compounds, Carbon, Copper, Zinc, Cadmium, Salinity, Bioavailability, Phytoplankton, Physico-chemical properties, Water column, Spatial distribution, Vertical distribution, Environmental gradient, Sorption.

Spatial distributions of copper (Cu), zinc (Zn) and cadmium (Cd) were followed along a longitudinal gradient of dissolved organic carbon (DOC) in South San Francisco Bay (South Bay). Dissolved Cu, Zn and Cd concentrations ranged from 24 to 66 nM, from 20 to 107 nM and from 1.2 to 4.7 nM, respectively, in samples collected on five dates beginning with the spring phytoplankton bloom and continuing through summer, 1985. Dissolved Cu and Zn concentrations varied indirectly with salinity and directly with DOC concentration. Available thermodynamic data strongly support the hypothesis that Cu speciation may be dominated by association with dissolved organic matter. Analogous control of Zn speciation by organic complexation was, however, not indicated in the computations. Computed free ion activity estimates for Cu, Zn and Cd were of the order of 10 to the minus 10th, 10 to the minus 8th and 10 to the minus 10th M, respectively. The availability of these metals may be among the factors regulating the growth of certain phytoplankton species within this region of the estuary. In contrast to dissolved Cu, dissolved Cd was directly related to the concentration of suspended particulate matter, suggesting a source of dissolved Cd coincident with elevated particle concentrations in the South Bay. Consistent with work in other estuaries, partitioning of all three trace metals onto suspended particulates was negatively correlated with salinity and positively correlated with increases in particulate organic carbon associated with the phytoplankton bloom. These results for the South Bay indicate that sorption processes influence dissolved concentrations of these trace metals, the degree of this influence varies among metals, and processes controlling metal distribution in this estuary appear to be more element-specific than spatialiy or temporally-specific. (Author's abstract)
W89-12605

CHARACTERIZATION OF INDIRECT PHOTOMETRY FOR THE DETERMINATION OF

INORGANIC ANIONS IN NATURAL WATER BY ION CHROMATOGRAPHY.
Montreal Univ. (Quebec). Dept. of Chemistry.
N. Chauret, and J. Hubert.
Journal of Chromatography JOCRAM, Vol. 469, No. , p 329-338, May 19 1989. 4 fig, 5 tab, 10 ref.

Descriptors: *High performance liquid chromatography, *Pollutant identification, *Photometry, *Inorganic compounds, *Anions, Chromatography, Natural waters, Laboratories, Performance evaluation, Gas liquid chromatography.

The determination of inorganic anions in natural water is becoming increasingly important as it allows a better understanding of environmental pollution. A high-performance liquid chromatographic method is based on indirect photometric detection, it may be used for analysis of inorganic anions in natural waters. Up to ten anions can be analyzed simultaneously with detection limits at the nanogram level. The working range covers three decades in concentration and the short term stability is around 1% for most anions. The validity of the method is proven by an inter-laboratory study and by the analysis of certified samples. The main advantages of this method over ion chromatography with suppressed conductivity detection are its simple response standardization and its simplicity as it involves conventional high-performance liquid chromatography equipment. (Author's abstract)
W89-12611

ISOCRATIC ELUTION OF SODIUM, AMMONIUM, POTASSIUM, MAGNESIUM AND CALCIUM IONS BY ION-EXCHANGE CHROMATOGRAPHY.
Yokohama National Univ. (Japan). Faculty of Engineering.
H. Sato.
Journal of Chromatography JOCRAM, Vol. 469, No. , p 339-349, May 19 1989. 7 fig, 1 tab, 11 ref.

Descriptors: *Calcium, *Sodium, *Potassium, *Magnesium, *Ammonium, *Separation techniques, *Cations, *Pollutant identification, *Chromatography, *Ion exchange, Chemical properties, Conductivity, Ultraviolet radiation, Precision, Detection limits, Interference, Elution, Electrochemistry.

Monovalent sodium, ammonium and potassium ions and divalent magnesium and calcium are found together in various aqueous samples such as environmental waters and biological fluids, and often all these species need to be determined. Isocratic elution conditions for five cationic species were investigated using conductivity and UV absorption detectors. Using several kinds of eluents and silica and styrene-divinylbenzene separation columns, the detection sensitivity, separation efficiency, separation time, system peak interference, etc., were examined. As a result, two types of eluents were concluded to be useful: a solution of benzylamine, citric acid and N-hydroxyethylenediamine-N,N',N'-triacetic acid (EDTA-OH) and a solution of 1,1'-di-n-heptyl-r,5'-bipyridinium (DHBP) ion and citric acid. When the former eluent is used, monovalent cations are separated clearly and divalent cations can be eluted without being captured in the column. With a slightly lower precision, divalent cations at the parts per million level can also be determined. The latter eluent is suitable mainly for determining Mg(2+) and CA(2+) ions with no interference from heavy metal ions. The separation of monovalent ions was poor with a commercially available separation column, but the detection sensitivity with a UV absorption detector was higher than that with the benylamine eluent. (Friedmann-PTT)
W89-12612

CAPILLARY GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC DETERMINATION OF ACID HERBICIDES IN SOILS AND SEDIMENTS.
Nagano Research Inst. for Health and Pollution (Japan).
T. Tsukioka, and T. Murakami.
Journal of Chromatography JOCRAM, Vol. 469, No. , p 351-359, May 19 1989. 5 fig, 1 tab, 16 ref.

Descriptors: *Soil analysis, *Sediment analysis, *Pesticides, *Pollutant identification, *Soil contamination, *Gas chromatography, *Mass spectrometry, *Herbicides, Chromatography, Soil environment, Organic compounds.

A capillary gas chromatographic method with selected-ion monitoring (GC-SIM) was applied to eight common herbicides: 2-(4-chloro-o-tolyl-oxy) propionic acid, 3,6-dichloro-2-methoxybenzoic acid, 2-methyl-4-chlorophenoxyacetic acid, 2,3,6-trichlorobenzoic acid, 2,4-dichlorophenoxyacetic acid, 3,5,6-trichloro-2-pyridyloxyacetic acid, 2,4,5-trichlorophenoxyacetic acid and alpha-(2-methyl-4-chlorophenoxy)butyric acid. The method involves extraction with saturated calcium hydroxide solution, esterification with pentafluorobenzyl bromide, clean-up with a silica gel column and determination by capillary GC-SIM. Recoveries from soil and sediment are over 89% (with the exception of 77% for TBA) with coefficients of variation below 5% (n = 7). The method is suitable for the simultaneous determination of the eight herbicides in environmental samples with high sensitivity and accuracy. (Author's abstract)
W89-12613

SCREENING OF GROUNDWATER CONTAMINANTS BY TRAVEL-TIME DISTRIBUTIONS.
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural and Biological Engineering.
For primary bibliographic entry see Field 5B.
W89-12614

RAPID DETERMINATION OF THE URBAN WASTEWATER POLLUTION.
Centro de Investigaciones del Agua, Madrid (Spain).
M. Gil, M. Cortijo, A. D. Barrionuevo, and J. A. Arias.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24, No. 4, p 323-330, May 1989. 2 fig, 1 tab, 6 ref.

Descriptors: *Chemical analysis, *Municipal wastewater, *Water analysis, *Biological oxygen demand, Chemical oxygen demand, Biochemistry, Volatile solids, Organic carbon, Manometers, Colorimetry, Digestion, Oxidation.

Many tests have been developed through the years to determine the organic pollution caused by urban effluents. The most important are volatile solids (VS), biological oxygen demand (BOD), chemical oxygen demand (COD), and organic carbon (OC). A method has been developed to determine BOD indirectly in 30 minutes. The method is based on the hypothesis that the biodegradable material is linearly correlated with the determination of the COD derived under soft digestion conditions (75 C for 30 minutes), the so called soft chemical oxygen demand (SCOD). BOD determination is done using the classical manometric method. SCOD, standard BOD sub 5 and calculated BOD sub 5 as well as reactive deviations were obtained using sulfates of mercury and silver, sulfuric acid and potassium dichromate along with a thermostatic digester and photocolorimeter. Results of the procedure showed that there is a linear relationship between the organic material which readily undergoes chemical oxidation, and BOD. The BOD can be quickly and directly calculated by means of the COD under soft conditions in a total of 30 minutes. The linear relationship between BOD and COD was found to exist under the hypothesized conditions. (Friedmann-PTT)
W89-12624

COEFFICIENT OF POLLUTION: PALOS VERDES CALIFORNIA SHELF 1973 AND 1984.
California State Univ., Long Beach. Dept. of Biology.
D. Maurer, and I. Haydock.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 5, p 219-222, May 1989. 2 fig, ? tab, 10 ref.

Descriptors: *Pollution index, *Coastal waters, *California, *Continental shelf, *Marine environment, *Water pollution effects, Wastewater disposal, Domestic wastes, Coastal zone management, Monitoring, Wastewater outfall, Effluents, Environmental policy, Monitoring.

Marine pollution monitoring studies have generated great masses of abiotic and biotic data; to reduce this vast data base to something readily understood by scientists and administrators alike for management purposes, a number of indices and analyses of pollution have been developed. While examining the effect of domestic waste discharge into the Mediterranean, researchers developed a coefficient of pollution (P). It was determined whether P, developed for the Mediterranean off Greece, could be meaningfully applied to major ocean outfalls on the Palos Verdes California shelf. P values were lower on the California Shelf than in the Gulf of Saronikos, Greece. Contour maps of P values revealed that there has been significant sediment transport from 1973 to 1984. In addition, the coefficient yielded patterns consistent with other local studies. Pending additional application of the coefficient to other Southern California ocean outfalls, this methodology may become a viable monitoring tool. (Author's abstract)
W89-12645

EFFECTS OF ORGANIC ENRICHMENT ON MEIOFAUNA: A LABORATORY STUDY.
Naples Univ. (Italy). Dipt. Genetica, Biologia Generale e Molecolare.
For primary bibliographic entry see Field 5G.
W89-12646

EVALUATION OF THE 7-H MEMBRANE FILTER TEST FOR QUANTITATION OF FECAL COLIFORMS IN WATER.
Los Angeles County Public Health Labs., CA.
R. Barnes, J. I. Curry, L. M. Elliott, C. R. Peter, and B. R. Tamplin.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 6, p 1504-1506, June 1989. 3 tab, 8 ref.

Descriptors: *Coliforms, *Membrane filters, *Pollutant identification, *Bacterial analysis, *Public health, Comparison studies, Statistical analysis, Testing procedures, California, Fecal coliforms, Performance evaluation, Quantitative analysis, Disasters.

The 7-h fecal coliform (FC) test for detection of FC organisms in water was evaluated to establish its validity and usefulness for emergency and disaster situations. The waters tested consisted of routine samples collected for public health surveillance and enforcement purposes. A total of 984 water samples from throughout California were assayed. These included samples from coastal salt waters, rivers, canals, and reservoirs, in addition to potable and miscellaneous freshwater sources. A portion of each sample was tested concurrently by both the 7-h FC test and the most-probable-number FC five-tube test. The 7-h FC test samples were incubated for 7 to 7.25 h at 41.5 C. Overall, greater than 90% agreement was obtained between the methods in determining whether the water quality was acceptable or unacceptable. Statistical analysis of the 984 samples confirmed that the 7-h FC method was a suitable alternative to the most-probable-number FC method for evaluation of freshwater samples. During emergencies or disasters, the 7-h FC test could provide a means for detection of fecal contamination of water with results available in less than 1 day. (Author's abstract)
W89-12656

SIGNIFICANCE OF THE AQUATIC MOSSES IN BIOGEOCHEMISTRY.
Sri Venkateswara Univ., Tirupati (India). Dept. of Geology.
For primary bibliographic entry see Field 7B.
W89-12676

CLEANUP OF ENVIRONMENTAL SAMPLE EXTRACTS USING FLORISIL SOLID-PHASE EXTRACTION CARTRIDGES.
Acurex Corp., Mountain View, CA. Environmental Systems Div.
V. Lopex-Avila, J. Milanes, and N. S. Dodhiwala.
Journal of Chromatographic Science JCHSBZ, Vol. 27, No. 5, p 209-215, May 5 1989. 2 fig, 8 tab, 10 ref. U.S.EPA contract 68-03-3226.

Descriptors: *Pollutant identification, *Sample preparation, *Cleanup, *Chlorinated hydrocarbons, *Phthalates, Interferents, Solvents, Adsorbents, Sample extracts, Florisil solid-phase extraction cartridges, Chemical analysis.

Disposable cartridges containing 1 g of Florisil were investigated for cleanup of extracts obtained from various environmental matrices. Elution patterns and recoveries were determined for 22 chlorinated hydrocarbons and 16 phthalate esters in the presence of interferents such as corn oil, diesel hydrocarbons, organochlorine pesticides, and chlorinated phenols. Hexane, hexane/diethyl ether (1:1), hexane/acetone (9:1), and various combinations of hexane/methylene chloride are used as eluants. From the 198 measurements, 68% of the measurements had recoveries >75%, 25% had recoveries ranging from 50 to 75%, 4% had recoveries <50% and 3% did not report a recovery because of matrix interference. Similarly, the procedure was tested for the phthalate esters with five environmental materials. In this case, recoveries were >74% for all phthalate esters but bis(2-ethoxyethyl)phthalate. The use of florisil cartridges reduces solvent and adsorbent usage and labor cost in sample preparation. In addition, because the cartridges are prepackaged and ready for use, there is no need for adsorbent calibration, activation, or deactivation. Furthermore, sets of 12 or 24 extracts, depending on the capacity of the vacuum manifold, can be cleaned up simultaneously with no danger of sample contamination; thus sample throughput is increased significantly. In addition, a significant error resulting from operator and material variables that may affect the quality of the results can be eliminated. (White-Reimer-PTT)
W89-12689

IONOMETRIC DETERMINATION OF CHLORINE IONS IN DESALTED WATER (IONOMETRICHESKOE OPREDELENIE IONOV KHLORA V OBESSOLENNOI VODE).
Nauchno-Issledovatel'ski Inst. Electroionnoi Technologii.
For primary bibliographic entry see Field 5F.
W89-12714

TOXICITY OF ALGAE AND THE DIFFICULTY OF ITS DETECTION IN NATURAL WATERS (A SURVEY) (TOKSICHNOST' VODOROSLEI I TRUDNOSTI II OBNARUZHENIIA V PRIRODNOI VODE (OBSOR)).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5C.
W89-12723

APPLICATION OF CLEARANCE CONCEPTS TO THE ASSESSMENT OF EXPOSURE TO LEAD IN DRINKING WATER.
California Univ., San Francisco. School of Pharmacy.
F. Y. Bois, T. N. Tozer, L. Zeise, and L. Z. Benet.
American Journal of Public Health AJHEAA, Vol. 79, No. 7, p 827-831, July 1989. 2 fig, 2 tab, 62 ref. CA DHS IMA 85-87088 and NIEHS grant ES-04705.

Descriptors: *Pollutant identification, *Lead, *Drinking water, *Population exposure, Toxicology, Clearance, Water quality standards.

Clearance is the proportionality constant between the rate at which the body eliminates an environmental toxicant, and its blood concentration. The application of clearance concepts to environmental toxicology is explored. Lead, for which a clearance of about 0.5 ml/min is estimated from published data, is chosen as an example. An index for the contribution of drinking water to total exposure is developed using these concepts. For lead, this index is shown to increase with the concentration of the metal in water; it is higher for children than for adults. At the maximum contaminant level (MCL) of 10 microg/L proposed by the Environmental Protection Agency, the average contribution from lead in drinking water is estimated to be 7%. The contribution in children is about twice as great. At and above the current MCL of 50 microg/L, drinking water becomes a major source of lead exposure. (Author's abstract)
W89-12728

EXTRACTION AND ISOLATION OF PHENOXY ACID HERBICIDES IN ENVIRONMENTAL WATERS USING TWO ADSORBENTS IN ONE MINICARTRIDGE.
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Chemica.
A. DiCorcia, M. Marchetti, and R. Samperi.
Analytical Chemistry ANCHAM, Vl. 61, No. 13, p 1363-1367, July 1, 1989. 2 fig, 4 tab, 29 ref.

Descriptors: *Separation techniques, *Phenoxy acid herbicides, *Pollutant identification, *Herbicides, *Chromatography, *Adsorbents, Isolation, Acidic water, Extraction, Cartridges, Natural waters, Carbon, Anion exchange, Detection limits.

Selective solid-phase extraction from environmental waters of nine popular acidic herbicides was accomplished by using one miniaturized cartridge containing in the top side 50 mg of a nonspecific adsorbent, that is graphitized carbon black (Carbopack B), and in the lower side 70 mg of a silica-based strong anion exchanger (SAX). After sample percolation, the SAX material was activated by passing through the trap sodium acetate, 1 mol/L. A 3-mL solvent mixture of CH2Cl2/CH3OH (80:20, by volume) basified with 1 mmol/L NaOH was then allowed to flow through the cartridge, and phenoxy acids were removed from the Carbopack surface and selectively readsorbed on the exchanger surface. After washing, the nine herbicides were desorbed from the SAX surface with 0.6 mL of water/methanol (50:5), by volume) containing trifluoroacetic acid and potassium chloride. A 100-microL portion of this solution was directly injected into the high performance liquid chromatography column, operating in the ion suppression-reversed-phase mode. As ion suppressor, the substitution of the commonly used acetic acid with trifluoroacetic acid allowed sensitive detection at 230 nm. Recovery of the nine acidic herbicides ranged between 94% and 100%, irrespective of the sample type considered. By this extraction method, basic, neutral, and weakly acidic compounds do not interfere with the analysis. Interestingly, this cartridge is suitable for field sampling, as Carbopack is able to adsorb phenoxy acids from water at whatever pH value. The limits of detection of the nine herbicides were well below 0.1 microg/L. (Author's abstract)
W89-12731

AUTOMATED SLURRY SAMPLE INTRODUCTION FOR ANALYSIS OF A RIVER SEDIMENT BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY.
Perkin-Elmer Corp., Norwalk, CT.
For primary bibliographic entry see Field 7B.
W89-12732

ANALYSIS OF TRIBUTLYTIN COMPOUNDS IN SHELLFISH BY USING GAS CHROMATOGRAPHY-MASS SPECTROMETRY.
Department of Scientific and Industrial Research, Petone (New Zealand). Chemistry Div.
D. J. Hannah, T. L. Page, L. Pickston, and J. A. Taucher.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 43, No. 1, p 22-27, July 1989. 1 fig, 4 ref.

Descriptors: *Organotins, *Antifoulants, *Mass spectrometry, *Pesticides, *Pollutant identification, *Shellfish, *Gas chromatography, *Tributlytin, Oysters, Spectrometry, Standards, Testing procedures, Comparison studies, Detection limits, Measuring instruments, Reproducibility, Electron capture gas chromatography, Experimental design, Animal tissue, Morphology.

The method and procedures required for the determination of tributyltin compounds in oyster samples are described. The recovery of tributyltin from oysters was measured by fortifying with bis(tributyltin)oxide. Ten g samples of uncontaminated oysters were fortified with 0.94, 1.9 and 4.7 microg. The recovery of bis(tributyltin)oxide was initially determined by comparison of the fortified sample-extracts with tributyltin hydride standards prepared from bulk analytical standard material. However, these standards were found to be unstable. After a period of 48 h, the standards in hexane gave peak areas less than 80% of the areas of the same standard rehydrogenated with sodium borohydride solution. The limit of detection for the method was 20 ng of tributyltin per g of oyster. This was determined by a signal-to-noise ratio of three for ion m/z 235, which had a relative abundance of 33% of the most abundant ion, mass m/z 179. One oyster sample was analyzed in triplicate. The use of high resolution gas chromatography-low resolution mass spectrometry has allowed determination of tributyltin in oysters at the part per billion (ng/g) level. The method has demonstrated reproducibility and sensitivity adequate to indicate significant levels of contamination. The use of a mass-selective detector has improved specificity over electron-capture detection. Oyster samples with shell perturbation and malformation had up to 140 ppb tributyltin in the flesh. (Miller-PTT)
W89-12734

PERIPHYTON, BENTHIC INVERTEBRATES AND FISHES AS BIOLOGICAL INDICATORS OF WATER QUALITY IN THE EAST BRANCH BRANDYWINE CREEK.
Pennsylvania Dept. of Environmental Resources, Norristown.
D. F. Knorr, and G. W. Fairchild.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 22, No. 4, p 20-29, July 17, 1989. 3 fig, 5 tab, 15 ref.

Descriptors: *Benthic fauna, *Macroinvertebrates, *Fish, *Bioindicators, *Water quality, Periphyton, Creeks, Pennsylvania.

Three groups of stream organisms, periphyton, benthic macroinvertebrates, and fish, were examined in relation to changing physicochemical conditions in the East Branch Brandywine Creek and its tributary Marsh Creek, Chester County, PA to compare their potential as biological indicators of water quality. The six sites chosen for study included two locations on the East Branch with low discharge and moderate nutrient concentrations above the Borough of Downingtown, three sites below Downingtown with higher nutrients, and one site on Marsh Creek below Marsh Creek Reservoir. Sampling was performed during July-August 1985. Periphyton standing crop varied among sites from 7-21 microg chlorophyll-a per sq cm of artificial substrate surface, showing evidence of nutrient limitation only below Marsh Creek Reservoir. Surber samples of benthic invertebrates were numerically dominated by filter feeding aquatic insects at all sites. The fish communities, sampled by electrofishing, ranged from 8-17 species among sites, with clear restrictions of many species to either upstream or downstream locations. The distributions of all three groups of organisms appeared to respond more strongly to physical variables, especially discharge and stream size, than to nutrient chemistry. (Author's abstract)
W89-12752

COMPARATIVE ANALYSIS OF POLYCHLORINATED DIBENZO-P-DIOXIN AND BIBENZOFURAN CONGENERS IN GREAT LAKES FISH EXTRACTS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY AND IN VITRO ENZYME INDUCTION ACTIVITIES.
Texas A and M Univ., College Station. Dept. of Veterinary Physiology and Pharmacology.
T. Zacharewski, L. Safe, S. Safe, B. Chittim, and

D. DeVault.
Environmental Science and Technology ESTHAG, Vol. 23, No. 6, p 730-735, June 1989. 3 fig, 6 tab, 49 ref.

Descriptors: *Fate of pollutants, *Dioxins, *Pollutant identification, *Gas chromatography, *Great Lakes, *Fish, Enzymes, Chlorinated hydrocarbons, Dibenzofurans, Bioassay, Mass spectrometry, Congeners, Comparison studies.

The high-resolution gas chromatographic-mass spectrophotometric (GC-MS) analysis of 25 Great Lakes fish extracts confirmed the identities of several 2,3,7,8-tetrasubstituted polychlorinated dibenzofurans (PCDFs) and dibenzo-p-dioxins (PCDDs). The dominant congener in extracts from lake Michigan, Lake Erie, Lake St. Clair, Lake Huron and Lake Superior fish was 2,3,7,8-tetrachlorodibenzofuran (TCDF). The fish extracts from Lake Ontario showed significant levels of 2,3,7,8-tetrachlorobenzo-p-dioxin (TCDD) besides containing considerable amounts of PCDFs. The 2,3,7,8-TCDD equivalents in these extracts were determined by their activities as inducers of aryl hydrocarbon hydroxylase (AHH) and ethoxyresorufin O-deethylase (EROD) in rat hepatoma H-4-II E cells in culture. For most of these samples, there was less than a 2-fold difference in the bioassay-estimated 2,3,7,8-TCDD equivalents and the total PCDDs plus PCDFs as determined by GC-MS. The bioassay-derived values were significantly (> 2-fold) higher for the Lake Erie and Lake Ontario fish extracts. This difference may be due to several factors including synergistic interactive effects of the congeners in the bioassay induction response or the presence f 'bioassay-active' components that are not detected by GC-MS analysis. (Author's abstract)
W89-12757

IDENTIFICATION AND DETERMINATION OF TERT-ALKYLPHENOLS IN CARP FROM THE TRENTON CHANNEL OF THE DETROIT RIVER, MICHIGAN, USA.
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
H. Shiraishi, D. S. Carter, and R. A. Hites.
Biomedical and Environmental Mass Spectrometry BMSYAL, Vol. 18, No. 7, pp. 478-483, July 1989. 2 fig, 1 tab, 14 ref. EPA Grant CR813524.

Descriptors: *Pollutant identification, *Trenton Channel, *Detroit River, *Michigan, *Organic solvents, *Carp, Water pollution, Tissue analysis, Gas chromatography, Mass spectrometry.

Whole carp from the Detroit River were analyzed by gas chromatographic mass spectrometry. Seven tertiary alkyl phenols (tert-pentylphenols, tert-butyl-tert-pentylphenols, a di-tert-pentylphenol and a tri-tert-pentylphenol) and eight chlorinated derivatives of these compounds were identified from their mass spectra and confirmed with synthesized authentic standards. 2,4-Di-tert-pentylphenol was the most abundant of these compounds; in one fish sample, its concentration was about 140 ppm. The same alkyl phenols were also found in technical-grade 2,4-di-tert-pentylphenol, which is manufactured at a chemical plant located near the Detroit River. Comparison of the alkyl phenol levels in carp with those in nearby sediments showed that many of these compounds are taken up by carp and that carp can be used to roughly track local sediment contamination. (Author's abstract)
W89-12770

RAPID AND QUANTITATIVE PENTAFLUOROBENZOYLATION OF NITROPHENOLS AND OTHER PHENOLIC COMPOUNDS IN WATER FOR GAS-CHROMATOGRAPHIC DETERMINATION WITH ELECTRON CAPTURE DETECTION.
Fraunhofer-Inst. fuer Toxikologie und Aerosolforschung, Hanover (Germany, F.R.).
H. D. Winkeler, and K. Levsen.
Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 334, No. 4, pp. 340-343, June 1989. 2 fig, 3 tab, 13 ref.

Descriptors: *Pollutant identification, *Catalysis, *Electron capture gas chromatography, *Phenols, *Nitrophenols, Pentafluorobenzoylation, Quantitative analysis, Ethers, Chemical reactions, Chemical analysis, Separation techniques.

Derivatization of nitrophenols in water with pentafluorobenzoylchloride for a gas-chromatographic determination with electron capture detection was achieved by phase transfer reaction using dicyclohexyl-18-crown-6 as catalyst. Only the phenols without nitro functionalities showed a high yield in the absence of a catalyst. It was apparent that the yield for nitrophenols is substantially increased in the presence of phase transfer catalysts. Crown ethers and in particular dicyclohexyl-18-crown-6 were very efficient catalysts for the extractive pentafluorobenzoylation of nitrophenols. The extractive acylation of the phenolic compounds can be described as a two-step reaction where the crown ether as phase transfer catalyst forms a complex with the cation of the potassium phenolate. The cation-complexed ion pair is then soluble in dichloromethane. The resulting naked phenolate is highly reactive and is easily acylated by pentafluorobenzoylchloride in the organic phase or at the phase boundary. (Mertz-PTT)
W89-12778

CYANOBACTERIAL TOXINS IN WATER.
Dundee Univ. (Scotland). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W89-12779

OCCURRENCE OF BACTERIOPHAGES INFECTING BACTEROIDES FRAGILIS AND OTHER VIRUSES IN POLLUTED MARINE SEDIMENTS.
Barcelona Univ. (Spain). Dept. of Microbiology.
J. Jofre, M. Blasi, A. Bosch, and F. Lucena.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 15-19, July 19, 1989. 5 tab, 12 ref. World Health Organization contract IPC/CWS, SPA 17.

Descriptors: *Pollutant identification, *Bacteriophage, *Enteroviruses, *Rotaviruses, *Water pollution sources, *Marine sediments, *Wastewater pollution, *Bioindicators, *Water analysis, Bacteroides.

Numbers of B. fragilis bacteriophages in comparison to coliphages, enteroviruses and rotaviruses were evaluated by different methods in sediments of a coastal area near Barcelona which receives substantial amounts of pollution of domestic origin. Phages infecting B. fragilis should be eluted from sediments prior to their enumeration, in the same way as solid-associated animal viruses. Phages infecting B. fragilis were better eluted by glycine buffer at alkaline pH than by a caotropic agent (beef extract-sodium nitrate). Such differences between glycine buffer and sodium nitrate were not evident when enteroviruses and rotaviruses were eluted from sediments. This suggests that elution with glycine buffer is preferable for bacteriophages, while the use of caotropic agents is advisable for animal viruses, because of the simplicity of the methodology. In the studied area, coliphages were the more abundant viruses. B. fragilis phages outnumbered rotaviruses and enteroviruses by a factor of more than ten. The ratios between phages active against B. fragilis and either enteroviruses or rotaviruses in marine sediments were similar to the ratios found in sewage, thus indicating that they have a similar fate. (Author's abstract)
W89-12780

GIARDIA AND VIRUS MONITORING OF SEWAGE EFFLUENT IN THE STATE OF ARIZONA.
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 3C.
W89-12784

EFFECT OF ESTUARY TYPE SUSPENDED SOLIDS ON SURVIVAL OF E. COLI IN SALINE WATERS.
Clyde River Purification Board, East Kilbride (Scotland).
D. P. Milne, J. C. Curran, J. S. Findlay, J. M. Crowther, and S. G. Wallis.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 61-65, July 19, 1989. 2 fig, 1 tab, 17 ref.

Descriptors: *Escherichia coli, *Coliforms, *Estuaries, *Suspended solids, *Water pollution, *Bioindicators, Artificial seawater, Salinity, Temperature, Survival time.

The effect of estuary type suspended solids on Escherichia coli inactivation was examined in laboratory experiments. The work used artificial seawater, laboratory processed suspended solids and chemostat steady-state E. coli cultures to establish the effect of these physical/chemical parameters on the viability of an E. coli population. Initial E. coli concentrations were 5000/100 ml, the temperatures employed were 10 C and 20 C, the suspended solids concentration range was 0-100 mg/L, salinity range 10-32 per mil, and the experimental vessels were completely shielded from light. The introduction of suspended solids at a low concentration (5 mg/L) markedly increased the survival time of E. coli at the higher salinities (32 and 27 per mil). Suspended solids at higher concentrations (> 12.5 mg/L) provided no additional increase in survival time. At low suspended solids concentrations (< or = 5 mg/L) decreasing salinity increased survival time; at higher suspended solids concentration (> 12.5 mg/L) salinities in excess of a critical value, around 27 per mil), also increased survival times. (Author's abstract)
W89-12787

VIRAL MULTICLONING PROCEDURE AND REPLICATES TECHNIQUE.
Centre de Recherche et de Controle des Eaux de Paris (France).
P. Vilagines, B. Sarrette, and R. Vilagines.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 85-92, July 19, 1989. 6 fig, 1 tab, 7 ref.

Descriptors: *Culturing techniques, *Viruses, Poliovirus, Multi-transferring virus technique.

The identification of virus particles is usually a lengthy process requiring extensive technical assistance. Studies of virus migration through agar media used for plaque assays demonstrated that it was possible to repetitively sample virus particles from a plaque with a pin and transfer them by pricking into an agar film pre-overlay on a cell monolayer. When antibodies were incorporated in the pre-overlay, it was possible to serotype the transferred virus with a 24 h response for poliovirus. This simple technique allows very fast sampling and identification of viral populations isolated from environmental sources, opening up a new direction for epidemiological studies. From a practical point of view, an implement was designed for the simultaneous transfer of several plaques in order to obtain replicas. (Author's abstract) (Sand-PTT)
W89-12791

NEW TECHNIQUE FOR THE ENUMERATION OF ROTAVIRUSES IN WASTEWATER SAMPLES.
Leeds Univ. (England). Dept. of Civil Engineering.
J. I. Oragui, D. D. Mara, S. A. Silva, and A. M. Konig.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 99-104, July 19, 1989. 3 tab, 21 ref.

Descriptors: *Wastewater analysis, *Stabilization ponds, *Viruses, *Enteroviruses, *Rotaviruses, Cytotoxicity, Dextran beads, Polyacrylamide beads, Immunofluorescence.

Rotaviruses are generally excreted in large numbers in diarrheal stools, but in wastewaters their numbers are subject to variations. Detection and enumeration of these viruses involve a concentration step followed by an assay method. Enumeration in wastewater concentrates is complicated by the presence of toxic substances which are often

concentrated with the viruses. These substances often cause the destruction of cells during the rotavirus assay, thus leading to underestimation of viral numbers. Such concentrates were detoxified by using polyacrylamide (Biogel P-6DG) or dextran (Sephadex G50) beads. Concentrates (10 ml) were mixed with 0.5 g gel and the mixtures were allowed to stand for 2 h at room temperature during which time the beads swell by the passage of water into them along with inorganic ions and substances with molecular weights <30,000. The supernatants were then decontaminated with antibiotics and assayed for rotaviruses by the indirect immunofluorescence technique. Most untreated ultrafiltrates of raw sewage and those from anaerobic ponds were found to be too toxic to MA104 and LLC MK2 cells, whereas the above treatment rendered more than 90% of wastewater concentrates non-toxic to cells. This technique was used to study virus removal in samples from deep waste stabilization ponds in northeast Brazil in 1986 and 1987. Rotavirus removal in both years ranged from more than 99.36% to 100%. About 90% of the samples from 1986 which could not originally be assayed due to cell toxicity were eventually detoxified by gel or bead treatment. The results indicate that the removal of rotaviruses in deep waste stabilization ponds was comparable with that in ponds of normal depth. (Sand-PTT)
W89-12793

OCCURRENCE OF ENTERIC VIRUSES IN POLLUTED WATER, CORRELATION TO INDICATOR ORGANISMS AND FACTORS INFLUENCING THEIR NUMBERS.
Rand Water Board, Vereeniging (South Africa).
J. C. Geldenhuys, and P. D. Pretorius.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 105-109, July 19, 1989. 1 fig, 5 tab, 17 ref.

Descriptors: *Viral identification, *Wastewater pollution, *Enteric viruses, *Enteric bacteria, *Coliforms, *Streptococci, *Bacteriophage, *Bioindicators, Seasonal variation, Water temperature.

Samples from a stream polluted with treated domestic effluent were examined for the presence of enteric viruses and indicator organisms (total and fecal coliforms, fecal streptococci and coliphages). Strong seasonal patterns in both the occurrence and number of epteric viruses, coliphages, and to a lesser extent fecal streptococci, were observed. The incidence of the highest and the lowest number of enteric viruses and coliphages plotted on a time scale followed a sine curve as opposed to the variations of temperature which followed an inverted sine curve. Indications are that the survival of these organisms is inversely proportional to temperature with lower temperatures (below 13 C) being conducive to a slower die-off rate. The square of the correlation coefficient between the viral numbers and temperature was calculated to be 0.4. This coefficient of determination only improved to 0.46 by combining data from other physical and physico-chemical and biological determinations. Temperature may be considered a useful aid in predicting the possible presence or absence of enteric viruses in raw water. Of all the indicator organisms examined only results on coliphages behaved similar to that of enteric viruses and should therefore be considered the best biological indicator for viral behavior under these circumstances. (Author's abstract)
W89-12794

SELECTION OF INDICATOR SYSTEMS FOR HUMAN VIRUSES IN POLLUTED SEAWATER AND SHELLFISH.
Pretoria Univ. (South Africa). Dept. of Medical Virology.
W. O. K. Grabow, G. K. Idema, P. Coubrough, and B. W. Bateman.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 111-117, July 19, 1989. 5 tab, 29 ref.

Descriptors: *Water pollution, *Wastewater pollution, *Viruses, *Enteroviruses, *Seawater, *Shellfish, *Coliforms, *Streptococcus, *Bacteriophage, *Bioindicators, *Public health, *Recreation, *Water analysis, Rotaviruses, Hepatitis virus, Reoviruses, Wastewater outfall.

A total of 610 samples of marine sewage discharges, polluted seawater and shellfish were analyzed for human enteric viruses and indicators of fecal/sewage pollution. Viruses were recovered by ultrafiltration from water samples of up to 10 liters, and by extraction from 50 g samples of shellfish meat. Detection of viruses was by cytopathogenic effect in primary vervet kidney cells. Some samples were tested for rotavirus and hepatitis A virus antigens using immunosorbent assays. Of the 202 samples from which viruses were cultured, 45% yielded enteroviruses and 87% reoviruses. The ratio of counts of viruses and indicators varied extensively in samples of both seawater and shellfish. Viruses or their antigens were detected in a number of samples which yielded negative results in conventional tests for at least one indicator. The results show that currently used quality criteria based on coliform indicators have shortcomings with regard to viruses. These findings, as well as experience and policies in other parts of the world, were applied in formulating revised quality criteria for seawater used for recreational purposes, and shellfish meat intended for human consumption. The recommended criteria include limits for human viruses, fecal coliforms, fecal streptococci and coliphages. The test methods used in conjunction with these criteria are considered important, and methods for viruses should be able to detect reoviruses. (Author's abstract)
W89-12795

APPLICATION OF GENE PROBES TO VIRUS DETECTION IN WATER.
Arizona Univ., Tucson. Dept. of Microbiology.
C. P. Gerba, A. B. Margolin, and M. J. Hewlett.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 147-154, July 19, 1989. 2 fig, 4 tab, 14 ref.

Descriptors: *Virus, *Enteroviruses, *Gene probes, *Water analysis, Groundwater, Drinking water, Marine sediments, Shellfish.

Gene probes offer a rapid and sensitive method for the detection of viruses in water and other environmental samples. Gene probes are small strands of nucleic acid labeled with radioactive or nonradioactive compounds for their detection. The target organism is identified by the hybridization of the probe to the organism's nucleic acid. Nucleic acid probes are at least 1000-fold more sensitive than serological tests such as enzyme-linked immunoassay and do not first require cultivation of the virus for detection. Gene probes have been developed for organisms that do not grow in cell culture, and probes have been constructed for most of the major groups of enteric viruses. Gene probes have been applied to the detection of enteric viruses in water, marine sediments and shellfish. Radioactively labeled probes can detect as little as 1-10 infectious units of virus within 48 h. A current disadvantage of probes is that they cannot determine the infectivity of the viruses; however, they can be used to quickly determine the growth of viruses in cell culture. Further development of nonradioactive probes should place virus detection capabilities into the hands of most water quality laboratories. (Author's abstract)
W89-12801

DEVELOPMENT AND OPERATIONAL IMPLEMENTATION OF A MODIFIED AND SIMPLIFIED METHOD FOR DETERMINATION OF ASSIMILABLE ORGANIC CARBON (AOC) IN DRINKING WATER.
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
F. A. Kemmy, J. C. Fry, and R. A. Breach.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 155-159, July 19, 1989. 2 fig, 2 tab, 9 ref.

Descriptors: *Drinking water, *Bacterial analysis, *Dissolved organic carbon, *Bioassay, Culturing techniques.

The concept of using a bioassay to measure the proportion of dissolved organic carbon in drinking water that is readily assimilable by microorganisms (AOC) was first introduced by Van der Kooij. The approach has subsequently been adapted by a number of research laboratories, but in general the methods used have been relatively expensive in equipment, materials and/or time. A modified and simplified assay procedure for AOC is based on incubation of the sterilized water sample with a defined mixed inoculum comprising 4 characterized bacterial species. At the end of a 6-day incubation period the amount of AOC present is directly related to the bacterial growth yield measured by a simple plate count. It is not necessary to determine growth curves for every sample, nor is it essential to calibrate each time the assay is used. The method was shown to give a linear response for mixed organic substrates between 0 and 1 million microgram C/L. Preliminary investigations into the AOC content of a range of different drinking waters both at treatment works and within distribution systems are reported. (Author's abstract)
W89-12802

RAPID DETECTION OF E. COLI IN WATER USING MONOCLONAL ANTIBODIES.
Centre de Recherche de Maisons-Laffitte (France).
J. C. Joret, P. Cervantes, Y. Levi, N. Dumoutier, and L. Cognet.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 161-167, July 19, 1989. 5 tab, 21 ref.

Descriptors: *Water analysis, *Escherichia coli, *Drinking water, *Bacterial analysis, Immunoassay, Monoclonal antibodies, Shigella.

The specificity of 3 polyclonal and 11 monoclonal antibodies (MoAb) directed against either an external constitutive protein of the outer membrane of Escherichia coli (porin OmpF) or an enzyme localized into the periplasmic space of this bacterium (alkaline phosphatase) was tested. Among 251 gram-negative bacteria tested, one MoAb was selected as being able to recognize specifically periplasmic enzyme extracts of E. coli (118 strains isolated from different sources, i.e. medical, fecal and environmental) and Shigella species (12 strains). This MoAb allows the recognition of whole cells of E. coli seeded in drinking water by using an immunofluorescent technique after preconcentration of bacteria on polycarbonate films. The potential applications of this technique for rapidly detecting E. coli from fecally polluted drinking water (less than 3 h) without the need of extended subcultures is discussed. In spite of their high reactivity, the anti-porin MoAb tested were unable to recognize all E. coli strains tested and did not distinguish between live and dead cells. (Sand-PTT)
W89-12803

DNA-RESTRICTION ENZYME ANALYSIS OF ADENOVIRUSES ISOLATED FROM WATERS.
Institut Pasteur Hellenique, Athens (Greece).
V. Krikelis, P. Markoulatos, N. Spyrou, V. Govari, and P. Karabatsas.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 169-172, July 19, 1989. 2 fig, 11 ref.

Descriptors: *Viruses, *Enteroviruses, *DNA, *Water analysis, Restriction enzymes.

Adenoviruses can often be isolated from waters in Greece. Serotype adenovirus 7 (Ad 7) was found most frequently, accounting for nearly 55% of all adenovirus isolates from water, with the protamine sulfate precipitation method used. The corresponding isolation rate of the Ad 7 serotype from humans was even higher, approaching 85% of all human isolates. This high frequency of occurrence of the Ad 7 serotype prompted a study of the DNA restriction enzyme analysis of Ad 7 strains so as to determine their genome type. Twenty-eight strains, 14 from waters and 14 from humans, were grown in Hep2 cells in the presence of radioactive phosphorus. Viruses were harvested after 24 h incubation, the DNA was extracted and digested with Bam HI and Xhol restriction enzymes, electrophoresed in agarose gels, vacuum dried and autoradiographed. The comparison of the restriction digests showed that all strains from waters and

12 out of 14 from humans belong to the genome type Adeno 7b, which is the most prevalent in other European countries as well. (Author's abstract)
W89-12804

RAPID, SPECIFIC AUTOANALYTICAL METHOD FOR THE SIMULTANEOUS DETECTION OF TOTAL COLIFORMS AND E. COLI FROM DRINKING WATER.
Yale Univ., New Haven, CT. School of Medicine.
S. C. Edberg, M. J. Allen, and D. B. Smith.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 173-177, July 19, 1989. 2 fig, 8 ref.

Descriptors: *Water analysis, *Escherichia coli, *Coliforms, *Drinking water, *Bacterial analysis, Autoanalysis Colilert test.

The Autoanalysis Colilert (AC) test is a modification of the defined substrate technology designed to enumerate specific target microbe(s) from a mixture of bacteria. The AC test simultaneously enumerates total coliforms and Escherichia coli directly from a water sample. A national United States evaluation of the method, covering a wide range of surface and subsurface water sources and water processing modalities, was conducted. The AC test was compared with Multiple Tube Fermentation (MTF) (quantitative) and presence-absence (P-A) (qualitative) Standard Methods procedures. The quantitative comparison showed that the AC test was slightly more sensitive than MTF. For 2 of the 5 sites it was more precise; for the other 3 it was equal. For the qualitative P-A the AC and Standard Methods analyses agreed 94%. The specificity of the AC method was established by subculturing a species of total coliform or E. coli from positives. The Autoanalysis Colilert method showed equivalent sensitivity and specificity to currently available standard methods. (Author's abstract)
W89-12805

COMPARATIVE RESISTANCE OF BACTERIOPHAGES ACTIVE AGAINST BACTEROIDES FRAGILIS TO INACTIVATION BY CHLORINATION OR ULTRAVIOLET RADIATION.
Barcelona Univ. (Spain). Dept. of Microbiology.
A. Bosch, C. Tartera, R. Gajardo, J. M. Diez, and J. Jofre.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 221-226, July 19, 1989. 5 fig, 1 tab, 17 ref.

Descriptors: *Drinking water, *Viruses, *Disinfection, *Viricides, *Chlorination, *Ultraviolet radiation, *Bacteriophage, *Bioindicators, Water treatment, Wastewater treatment, Bacteroides, Poliovirus, Rotavirus.

In order to assess the potential usefulness of bacteriophage active against Bacteroides fragilis for the monitoring of viral disinfection in environmental samples, the sensitivity to chlorination and to UV irradiation of phage B40-8 was evaluated in comparison to that of poliovirus type 1 (LSc2ab), simian rotavirus SA11, coliphage f2, Escherichia coli and Streptococcus faecalis. The inactivation of the different microorganisms by chlorine or UV treatment was monitored in tap water and sewage. The results indicated that viruses persisted significantly ($p<0.05$) longer than bacteria in the presence of both disinfectants. Phage B40-8 was the most resistant microorganism to chlorination ($p<0.05$) while coliphage f2 was the most resistant to UV irradiation. In the latter, phage B40-8 was nevertheless as resistant as poliovirus and rotavirus. As expected, all microorganisms were significantly ($p<0.05$) more resistant to both disinfection procedures in sewage than in tap water. These studies suggest the use of phage B40-8, instead of indicator bacteria, for the monitoring of viral disinfection in sewage-polluted water. (Author's abstract)
W89-12811

RECOVERY OF STAPHYLOCOCCI SPECIES FROM MARINE RECREATIONAL WATERS OF PUEBLA DE FARNALIS (VALENCIA, SPAIN).
Universidad Politecnica de Valencia (Spain). Dept. of Hydraulic and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W89-12813

DISTRIBUTION OF MESOPHILIC AEROMONADS IN TEMPERATE AQUATIC HABITATS: RELATIONSHIP WITH FAECAL INDICATORS.
Barcelona Univ. (Spain). Dept. of Microbiology.
R. M. Araujo, R. M. Arribas, F. Lucena, and R. Pares.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 247-250, July 19, 1989. 2 fig, 3 tab, 14 ref.

Descriptors: *Aeromonas, *Wastewater pollution, *Bacterial analysis, *River water, *Coastal waters, *Drinking water, *Chlorination, Population dynamics, Seasonal variation, Biochemical oxygen demand, Spain, Wastewater analysis, Water analysis.

The concentration and distribution of mesophilic aeromonads in a variety of waters (domestic wastewater, treated effluent, freshwater, seawater, and tap water) in Spain were investigated. Aeromonas species were isolated from all the domestic wastewater samples at a constant density of between 10 million and 100 million colony forming units (CFU)/100 ml. While these bacteria are not of fecal origin, they were found in numbers similar to fecal coliforms because they were able to multiply in sewage. In sewage treatment plant effluents, aeromonads were isolated from about 90% of the samples with a range of 100-1,000,000 CFU/100 ml. The frequency of isolation of these bacteria was 67% in samples from the plant using chlorination, indicating the efficacy of chlorine in controlling these organisms in water. Aeromonas species were found in all the river samples, with numbers ranging from 1000 to 100 million CFU/100 ml. The lowest numbers were found at a non-polluted sampling site, which also had the lowest BOD concentration. At sites directly affected by sewage effluent, the BOD was high, as was the number of Aeromonas spp. The number of organisms was directly related to the distance from the sewage outlet and the dilution of the sewage. Aeromonas species, while considered freshwater species, were isolated from all the coastal samples at levels ranging from 10 to 10,000 CFU/100 ml. An investigation of the population dynamics of aeromonads in the rivers and along the coast showed that the numbers of these organisms are quite constant throughout the year. Aeromonas species were also isolated from 70% of the tap water samples, although they were found in low numbers (1 CFU/100 ml). (Sand-PTT)
W89-12815

HEPATITIS A VIRUS CONCENTRATION FROM EXPERIMENTALLY CONTAMINATED DISTILLED, TAP, WASTE AND SEAWATER.
Centre de Recherches du Service de Sante des Armees, Lyon (France). Div. de Microbiologie.
E. Biziagos, J. Passagot, J.-M. Crance, and R. Deloince.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 255-258, July 19, 1989. 4 tab, 18 ref.

Descriptors: *Virus, *Water analysis, *Enteroviruses, *Drinking water, *Seawater, *Wastewater analysis, *Human diseases, Hepatitis A virus, Concentration method, Culturing techniques.

The concentration of cell culture-adapted hepatitis A virus (HAV) from experimentally contaminated distilled, drinking, waste and seawater was performed by using a filter adsorption-elution method in the following conditions: HAV seeded in water was adsorbed at pH 4.0 to two nitrocellulose membranes (1.2 and 0.45 micron porosity for distilled and tap water or 8.0 and 3.0 micron porosity for waste and seawater), then eluted by 3% beef-extract at pH 8.5 and further concentrated by polyethylene glycol 6000 precipitation. Thus, HAV in 5 to 50 liters of seeded water was concentrated approximately 1700 to 17,000-fold with >70% recovery of the initial virus added to the samples. (Author's abstract)
W89-12817

COMPARISON OF METHODS FOR CONCENTRATING COLIPHAGES AND ENTEROVIRUSES IN RAW AND DRINKING WATER.
Tuebingen Univ. (Germany, F.R.). Hygiene Inst.
T. Hahn, M. Karst, D. Tougianidou, and K. Botzenhart.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 259-262, July 19, 1989. 3 fig, 1 tab, 7 ref.

Descriptors: *Water analysis, *Viruses, *Drinking water, *Bacteriophage, *Enteroviruses, *Flocculation, *Filtration, Poliovirus.

A study compared flocculation and filtration methods for concentrating coliphages and viruses in water samples taken from different water sources in the vicinity of Tubingen. For the flocculation method, recovery of coliphages and polioviruses was more effective with $MgCl_2$ than with $Al_2(SO_4)_3$. Filtration using Virosorb 1 MDS filters was more effective than flocculation. The recovery of viruses increased with the number of filters used. Combination of more than 3 filters proved to be difficult to use. The recovery of coliphages from environmental samples was somewhat better using the filtration method with Virosorb 1 MDS filters than with the flocculation method with $MgCl_2$; however, for some types of coliphages, the $MgCl_2$-flocculation method was more efficient. The recovery of coliphages and polioviruses was closely connected with water quality. Anionic detergents and lignin-sulfonic acid as a representative reagent of humic acids showed a strong negative effect on the recovery of coliphages. Other factors in question (non-ionic detergents, polysaccharides) had little or no effect. The influence of water components was stronger using filtration methods than using flocculation. Methods for the detection of coliphages were more sensitive if divalent cations (Mg) were present. Optimal conditions were established for the concentration methods (e.g. pH values) in waters of varying composition. (Sand-PTT)
W89-12818

IMPROVED METHODS FOR THE EVALUATION OF DRINKING WATER QUALITY BY DETECTING ENTEROBACTERIA.
Tuebingen Univ. (Germany, F.R.). Hygiene Inst.
T. Hahn, A. Wiedenmann, and K. Botzenhart.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 263-266, July 19, 1989. 2 fig, 9 ref.

Descriptors: *Drinking water, *Water analysis, *Bioindicators, *Bacterial analysis, *Enteric bacteria, *Coliforms, Escherichia coli, Enterobacter, Klebsiella, Citrobacter, Yersinia, Shigella, Salmonella, Streptococcus, Comparison studies, Water quality standards, West Germany.

The German Regulations for Drinking Water (TrinkwV) provide criteria for the detection of E. coli or coliform bacteria. However, the criteria describing coliforms are fulfilled not only by E. coli but also by Citrobacter, Enterobacter and Klebsiella. The difficulties in defining coliform bacteria has led to an alternative approach in which water samples are checked for all enterobacteria. Following the TrinkwV criteria, 180 out of 2064 samples were rejected. Another 140 samples were rejected due to detection of enterobacteria; 38.6% of these samples contained lactose-negative 'coliform bacteria' of the genera Escherichia, Citrobacter, Enterobacter and Klebsiella; 29.3% included lactose-negative bacteria of the genera Hafnia and Serratia, and 32.1% were lactose-positive enterobacteria fermenting lactose, which were not comprised in the TrinkwV. Ninety-eight percent of all isolated enterobacteria were of the genera Escherichia, Citrobacter, Enterobacter, Klebsiella, Hafnia and Serratia. No Salmonella, Shigella or Serratia could be detected. Raw water showed the highest enterobacteria contamination rate. Enterobacteria were found 3-4 times more frequently in untreated than in treated water. About 3 times more enterobacteria were found in private than in public water supply sys-

tems. In general, checking for enterobacteria increased the number of rejected water samples compared to the figures obtained following the TrinkwV guidelines. The largest differences could be observed in untreated water from public water supply systems and in raw water; the smallest difference was found in chlorinated drinking water. The presence of enterobacteria is a good indicator for the occurrence of fecal streptococci; 73% of the samples containing enterobacteria contained fecal streptococci as well. E. coli and coliform would not serve as well as indicators for fecal streptococci. Only 62% of the positive samples would contain fecal streptococci. (Sand-PTT)
W89-12819

CYTOCHROME OXIDASE AND O-NITROPHENYL-BETA-D-GALACTOPYRANOSIDE FOR IMPROVED AND RAPID CONFIRMATION OF COLIFORMS ENUMERATED BY THE MEMBRANE FILTRATION METHOD.
Welsh Water Authority, Llanelli. South West District Lab.
For primary bibliographic entry see Field 5F.
W89-12821

COMPARISON OF TWO METHODS FOR VIRUS RECOVERY FROM MUSSELS AND OYSTERS.
Nancy-1 Univ. (France). Faculte de Pharmacie.
L. Schwartzbrod, H. Montanie, and C. Lambert.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 291-293, July 19, 1989. 1 tab, 15 ref.

Descriptors: *Viruses, *Food contamination, *Shellfish, *Mussels, *Oysters, Extraction methods, Poliovirus.

Two viral extraction methods using mussels and oysters contaminated under conditions approaching natural ones were compared. The Finance extraction method is accomplished by the action of a saline solution, pH 9, directly on the visceral mass. The Baron method is based on elution of the virus from finely ground and homogenized shellfish tissue using a glycine buffer, pH 10. The Finance method includes a concentration step using ultracentrifugation while the Baron method does not, so a secondary concentration step using a method described by Katzenelson was incorporated. The Baron method was shown to be much more effective for recovery of poliovirus from oysters and mussels; total recoveries were 4-fold to 5-fold higher for mussels and 4-fold to 7-fold higher for oysters using the Baron method compared to the Finance one. Addition of the Katzenelson concentration step to the Baron extraction did not improve the final recovery but did facilitate viral isolation and quantification by reducing the eluate volume 4-fold. Viral recovery from finely ground and homogenized shellfish tissue is thus clearly more efficient than that obtained from extraction of the visceral mass. Nonetheless, the former method should be coupled with a secondary concentration step. (Sand-PTT)
W89-12826

RAPID DETECTION OF POLIOVIRUS FROM WATERS USING MONOCLONAL ANTIBODIES.
Public Health Lab. Service, Reading (England). Royal Berkshire Hospital.
J. Sellwood, and L. Smith.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 299-301, July 19, 1989. 7 ref.

Descriptors: *Water analysis, *Viruses, *Poliovirus, *Monoclonal antibodies, Immunofluorescence, Culturing techniques.

Poliovirus is present in many types of water in the environment. A rapid detection method for the presence of poliovirus could be relevant to water management. Virus components are present in cell culture from 6-18 hours after infection. The indirect immunofluorescent staining technique can be used to detect the components. Monoclonal antibodies may provide specific and sensitive reagents for this test. Two of more than 50 mouse monoclonal antibodies screened were able to recognize and attach to poliovirus 3 infected cells. The time at which fluorescence was detected was dependent on the initial virus concentration. These two monoclonals recognize 'early' produced structural protein before its configuration into a mature capsid. (Author's abstract)
W89-12828

ASSESSMENT OF VARIOUS CELL LINES (INCLUDING MIXED-CELL CULTURES) FOR THE DETECTION OF ENTERIC VIRUSES IN DIFFERENT WATER SOURCES.
Tuebingen Univ. (Germany, F.R.). Hygiene Inst.
D. Tougianidou, M. Jacob, K. Herbold, T. Hahn, and B. Flehmig.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 311-314, July 19, 1989. 1 fig, 2 tab, 5 ref.

Descriptors: *Water analysis, *Viruses, *Enteroviruses, Cell cultures, Reoviruses, Coxsackie virus, Echovirus.

In testing water samples from different sources for possibly pathogenic enteric viruses, one usually faces a problem: viruses are highly selective with regard to cell cultures. Negative results in one cell culture do not signify that the water is free of viruses. In order to develop tests both sensitive and reliable a series of assays with 6 different cell lines were developed. Within the spectrum of these 6 lines a wide variety of enteric viruses could be detected, including reoviruses, coxsackie, and echoviruses. In addition to being reliable the tests should be cost-efficient and easy to handle. (Author's abstract)
W89-12831

OCCURRENCE OF CHLOROBENZENE ISOMERS IN THE WATER COLUMN OF A UK ESTUARY.
Water Research Centre, Medmenham (England).
For primary bibliographic entry see Field 5B.
W89-12854

DISTRIBUTION AND FRACTIONATION OF HEAVY METALS IN THE CAUVERY ESTUARY, INDIA.
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
V. Subramanian, A. Ramanathan, and P. Vaithyanathan.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 6, p 286-290, June 1989. 4 fig, 3 tab, 18 ref.

Descriptors: *Pollution load, *Pollutant identification, *Heavy metals, *Estuaries, *India, *Marine sediments, *Suspended sediments, Mercury, Cadmium, Aluminum, Iron, Zinc, Manganese, Copper, Nickel, Chromium.

Samples of freshly deposited bed sediments and water samples collected at six locations from the Cauvery Estuary, India were analyzed for major and minor metals. Total suspended sediments, bed sediments, and size fractionated sediments were analyzed in triplicate. The concentration of Fe, Mn, Zn, Cu, Cd, and Hg were enriched in the suspended sediments relative to the bed sediments due to finer size and organic matter content. The < 4 micrometer fractions were enriched in Cu, Ni, Cr, Cd, and Hg when compared with their corresponding values in suspended and bed sediments, although the < 4 micrometer fractions were enriched in clay fractions. Fe and Mn levels in the Cauvery estuarine sediments appeared to be on the lower side when compared to the other tropical estuaries of India such as the Godavari and Krishna. The suspended sediments and < 4 micrometer fractions showed an enrichment in heavy metal concentration. The high percentage of the clays in the < 4 micrometer fractions of the estuarine bed sediments and the suspended sediments suggest that the detrital components in the sediment do not contribute major amounts of heavy metals to the sediments. The enrichment of heavy metals in the particulates, as well as the < 4 micrometer fractions of bed, may be due to exchange by resuspension or settling, between these two components. The metal/Al ratio in the sediments generally increases downstream in the estuary. (Geiger-PTT)
W89-12856

ORGANOTIN COMPOUNDS IN HARBOUR AND MARINA WATERS FROM THE NORTHERN TYRRHENIAN SEA.
Siena Univ. (Italy). Dipt. di Biologia Ambientale.
For primary bibliographic entry see Field 5B.
W89-12857

COMPARISON OF THE EFFECT OF TRICLOPYR TRIETHYLAMINE SALT ON TWO SPECIES OF DUCKWEED (LEMNA) EXAMINED FOR A 7- AND 14-DAY TEST PERIOD.
Dow Chemical Co., Midland, MI. Dept. Health and Environmental Sciences.
For primary bibliographic entry see Field 5C.
W89-12866

EVALUATION OF MANUFACTURED INOCULA FOR USE IN THE BOD TEST.
Trinity Coll., Dublin (Ireland). Environmental Sciences Unit.
G. D. Fitzmaurice, and N. F. Gray.
Water Research WATRAG, Vol. 23, No. 5, p 655-657, May 1989. 1 tab, 5 ref.

Descriptors: *Biochemical oxygen demand, *Water quality, *Testing procedures, Comparison studies, Wastewater.

While the biochemical oxygen demand (BOD5) test remains a major water quality measurement, its repeatability is poor. A dehydrated microbial seed (Bioseed) was compared with seeds taken from various effluent treatment works using a standard glucose/glutamic acid solution. A 2% dilution of the stock glucose/glutamic acid solution was prepared using nutrient dilution water. Each batch was aerated and seeded with the respective seeds at the rate of 5 ml seed/liter dilution water. The dissolved oxygen concentration in the samples, both before and after incubation was determined using the azide modification of the iodometric method. The repeatability estimate for the dehydrated microbial seed was significantly better than that attained using either raw or treated effluents as seed. However, the accuracy of the BOD5 test was not significantly improved by the use of the dehydrated seed, compared with fresh wastewater seeds, when seven replicates were used. (Geiger-PTT)
W89-12870

BACTERIOLOGICAL MONITORING OF SEAWATER: I. CORRELATION BETWEEN FECAL AND TOTAL COLIFORMS AND INTERPRETATION OF THE RESULTS ACCORDING TO THE PRESENT STANDARDS.
Aix-Marseille-2 Univ. (France). Lab. de Microbiologie.
C. Meynard, J. P. Reys, R. Phan-Tan-Luu, and G. Dumenil.
Water Research WATRAG, Vol. 23, No. 5, p 663-666, May 1989. 3 fig, 4 tab, 10 ref.

Descriptors: *Water quality, *Coliforms, *Seawater, *Monitoring, *Streptococcus, Swimming, Correlation coefficient, France, Bioindicators, Water quality.

In France, the bacteriological monitoring of recreational seawaters includes the determination of total coliforms, fecal coliforms and fecal streptococci. Then, the sampling locations are classified in four groups (A, B, C and D) according to the French guidelines. Data of five laboratories on the French Mediterranean coast were statistically analyzed during a 3-yr period (7821 samples). Correlation coefficients were calculated and principal component analysis was determined. Correlation coefficients between total coliforms and fecal coliforms were found to be significant for all laboratories (confidence level = 99%). However, a linear relationship between total coliforms and fecal coliforms could not be calculated. Principal component analysis showed a redundance of total and

fecal values to determine the fecal contamination of recreational seawaters and the average microbial pollution did not always correlate with the French classification of the seawater quality. (Author's abstract)
W89-12872

SCREENING OF GROUND WATER SAMPLES FOR VOLATILE ORGANIC COMPOUNDS USING A PORTABLE GAS CHROMATOGRAPH.
Geological Survey, Iowa City, IA.
R. C. Buchmiller.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 3, p 126-130, 1989. 4 fig, 3 tab, 3 ref.

Descriptors: *Water analysis, *Gas chromatography, *Water sampling, *Organic compounds, *Pollutant identification, Volatility, Laboratory equipment, Field tests.

A portable gas chromatograph was used to screen 32 ground water samples for volatile organic compounds. Seven screened samples were positive; four of the seven samples had volatile organic substances identified by second-column confirmation. Four of the seven positive, screened samples also tested positive in laboratory analyses of duplicate samples. No volatile organic compounds were detected in laboratory analyses of samples that headspace screening indicated to be negative. Samples that contained volatile organic compounds, as identified by laboratory analysis, and that contained a volatile organic compound present in a standard of selected compounds were correctly identified by using the portable gas chromatograph. Comparisons of screened-sample data with laboratory data indicate the ability to detect selected volatile organic compounds at concentrations of about one microgram per liter in the headspace of water samples by use of a portable gas chromatograph. (Author's abstract)
W89-12876

IN-HOUSE WELL DRILLING OPERATIONS FOR A GROUND WATER MONITORING PROGRAM, SUFFOLK COUNTY, NEW YORK.
Suffolk County Dept. of Health Services, Hauppauge, NY. Groundwater Resources Bureau.
For primary bibliographic entry see Field 7A.
W89-12879

AQUATIC INVERTEBRATE SURVEYS AS A WATER QUALITY MANAGEMENT TOOL IN THE ANGLIAN WATER REGION.
Anglian Water Authority, Lincoln (England). Lincoln Div.
C. A. Extence, and A. J. D. Ferguson.
Regulated Rivers Research and Management RRRMEP, Vol. 4, No. 2, p 139-146, July 8, 1989. 12 tab, 13 ref.

Descriptors: *Lincoln Quality Index, *Water quality management, *Bioindicators, *Monitoring, *Bioindicators, *Environmental policy, Pollution load, Wastewater treatment, Economic aspects.

Biological data were used to manage water quality in the Anglian Water region. The Lincoln Quality Index, (LQI) employs invertebrate populations as bioindicators due to their sedimentary behavior and range of response to both toxic and organic pollutants. LQI values range from A, excellent to I, very poor quality. LQI targets for review quality objectives are: B for salmonid fisheries, C for direct potable water supply. D for potable water supply via impoundment and cyprinid fisheries. This technique was used in detecting and determining the significance of intermittent and shock pollution loads in Lincoln Chalk streams as well as determining the impact of deteriorating sewage effluent quality. The adoption of the Lincoln Quality Index method offers the opportunity for substantial cost savings, as well as allowing water quality surveillance programs to be undertaken with increased flexibility. (Author's abstract)
W89-12913

METHODS FOR GROWTH INHIBITION TOXICITY TESTS WITH FRESHWATER ALGAE.
Vandkvalitetsinstitutet, Hoersholm (Denmark).
N. Nyholm, and T. Kallqvist.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 8, p 689-703, 1989. 2 fig, 1 tab, 80 ref.

Descriptors: *Toxicity, *Bioassay, *Toxicology, *Algae, Reviews, Laboratory methods, Culturing techniques, Data interpretation.

A critical review of batch-culture freshwater algal toxicity test methods (algal growth inhibitions tests) is presented. Interlaboratory comparisons have revealed that the results from such tests can vary greatly, in some cases by more than three orders of magnitude. The potential causes of variability are the physical/chemical experimental parameters. Algal tests, however, need not be strictly standardized in order to be reproducible if tests are appropriately conducted and the experimental parameters are understood and controlled. Many algal toxicity data reported in the literature seem to have been generated from tests performed with an excessively high biomass and under poor gas-exchange conditions, the combination of which will cause an insufficient supply of carbon dioxide leading to high pH levels and sometimes even to mass-transport (carbon dioxide)-limited linear growth. Poor gas-exchange conditions will prevail unless the test flasks are shaken or aerated continuously. Literature data on the toxicity of chemicals to algae should therefore be used only with careful evaluation of the test method involved. (Author's abstract)
W89-13024

MARINE COMPLEX EFFLUENT TOXICITY PROGRAM: TEST SENSITIVITY, REPEATABILITY AND RELEVANCE TO RECEIVING WATER TOXICITY.
Environmental Research Lab., Narragansett, RI.
S. C. Schimmel, G. E. Morrison, and M. A. Heber.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 8, p 739-746, 1989. 1 fig, 5 tab, 11 ref.

Descriptors: *Toxicity, *Toxicology, *Water analysis, *Marine plants, *Marine algae, *Fish, *Invertebrates, *Pollutant identification, *Bioassay, Industrial wastewater, Municipal wastewater, Effluents, Echinoderms, Mysids, Estuaries, Laboratory methods, Coastal waters.

In March 1984, the U.S. Environmental Protection Agency issued a significant change in procedures regulating toxic materials in effluents through the National Pollutant Discharge Elimination System (NPDES). Concurrent with this toxicity-based effluent control policy, the EPA established the marine/estuarine component of the Complex Effluent Toxicity Testing Program (CETTP). The CETTP was established to provide reliable, sensitive and environmentally meaningful test protocols that could be used to detect toxic industrial and municipal effluents within the NPDES. Five toxicity test methods have been developed and validated for the program since 1984 using a marine plant (Champia parvula), two invertebrates (Arbacia punctulata and Mysidopsis bahia) and two fish (Cyprinodon variegatus and Menidia beryllina). The laboratory precision test results for the methods were acceptable; coefficients of variation for all methods were less than 54%, averaging 34%. Numerous field tests were conducted using these methods and the results indicate that tests on receiving waters (in which effluent concentrations could be estimated through controlled dye studies) accurately reflect the toxicity of the effluents measured directly. Receiving water impacts, when observed, were generally near-field in nature. The test methods developed are sensitive, efficient, reliable and environmentally relevant measures of effluent toxicity and offer promise for reducing adverse impacts from point-source discharges in near-coastal waters. (Author's abstract)
W89-13028

EFFECT OF SUPPLEMENTARY DIETARY COPPER ON COPPER AND METALLOTHIONEIN LEVELS IN THE FISH, DAB, LIMANDA LIMANDA.
Institute of Marine Biochemistry, Aberdeen (Scotland).
J. Overnell, and R. McIntosh.
Marine Environmental Research MERSDW, Vol. 26, No. 4, p 237-247, 1988. 1 fig, 3 tab, 21 ref.

Descriptors: *Fish, *Copper, *Bioassay, *Pollutant identification, *Metallothioneins, Dab, Limanda, Zinc, Liver, Kidneys, Tissue analysis.

Common dab were fed a casein based diet containing Cu at a concentration of 1.4 mg Cu/kg (dry weight) or a similar diet supplemented with 200 mg Cu/kg. Fish were sampled after 10 weeks and 20 weeks and hepatic and renal Cu, Zn and metallothionein concentrations were measured. All hepatic cytosolic Cu in test and control fish co-eluted from Sephadex G-75 with metallothionein, as did some of the cytosolic Zn. After 20 weeks there was three times as much of this metallothionein-bound Cu in the livers of the test fish compared to the controls, although metallothionein concentration was little elevated. It is proposed that cytosolic liver Cu concentration or heat stable liver Cu concentration can be used as an indication of excess dietary Cu in the dab Limanda limanda. (Author's abstract)
W89-13039

ENVIRONMENTAL HAZARD OF EIGHT CHEMICALS PRESENT IN THE RHINE RIVER.
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
E. Halfon, and R. Bruggemann.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 815-820, 1989. 1 fig, 3 tab, 13 ref.

Descriptors: *Risk assessment, *Graphical methods, *Numerical analysis, *Rhine River, *Hazardous materials, *Chemical analysis, Rivers, Toxicity, Disulfoton, Dinitroorthocresol, Propetamphos, Thiometon, Parathion, Etrimphos, Metoxuron, Fenitrothion.

The environmental hazard is ranked for eight chemicals: (1) Disulfoton, (2) Dinitroorthocresol, (3) Propetamphos, (4) Thiometon, (5) Parathion, (6) Etrimphos, (7) Metoxuron, (8) Fenitrothion. Five attributes related to the toxicity, physicochemical characteristics and the fate are used to rank the chemicals. Results by two ranking methods show that these chemicals can be divided into two groups, (the most hazardous including Dinitroorthocresol, Propetamphos, and Parathion and the least hazardous including Disulfoton, thiometon, Etrimphos, Metoxuron and Fenitrothion). Hasse diagrams allow one to visually compare chemicals based in many test results which might otherwise be very confusing when displayed in a table form. The Hasse diagram is an effective graphical display of data difficult to understand otherwise. The ranking procedure, using a vectorial approach, is applicable to a variety of problems in environmental toxicology. Once data have been collected, a computer can process them in a few seconds. A graphical display program has been developed for desktop computers. The number of classification levels is directly proportional to the number of chemicals and inversely proportional to the number of criteria; in fact, the more criteria considered at the same time, the higher the probability of contradictions in the data and the higher the probability of having fewer discrimination levels. (Miller-PTT)
W89-13058

BACILLUS SUBTILIS/MICROSOME REC-ASSAY FOR THE DETECTION OF DNA DAMAGING SUBSTANCES WHICH MAY OCCUR IN CHLORINATED AND OZONATED WATERS.
Kyoto Univ., Otsu (Japan). Lab. for Control of Environmental Micropollutants.
S. Matsui, R. Yamamoto, and H. Yamada.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 875-887, 1989. 13 ref. Japan Ministry of Education, Science and Culture no. 61850102.

Descriptors: *Bacillus, *Mutagenicity, *Nucleic acids, *Bioassay, *Water treatment, *Wastewater treatment, *Wastewater disposal, *Chlorination, *Ozonation, Deoxyribonucleic acid, Chloroform, Bromoform, Heptachlor, DDT, Trichloroethylene, Acetaldehyde, Propionaldehyde, Carvone, Hexachloropentadiene.

The liquid Bacillus subtilis/microsome recombination-assay method was applied to twenty chlorinated chemicals and fourteen aldehydes which may occur in chlorinated and ozonated waters. The results showed that substances could be classified into four categories: (1) strongly DNA damaging, (2) DNA damaging, (3) not DNA damaging, and (4) reverse. A new indicator, rec-gram, was introduced to quantitatively evaluate the DNA damaging potential of substances. Bromoform, chloroform, dibromochloromethane, dichlorobromomethane, carbontetrachloride, tetrachloroethylene, and six other chlorinated chemicals showed direct or indirect DNA damaging potential. Heptachlor, trans-chlordane, p,p'-DDT, and three other chemicals showed the reverse effect with or without S9 activation. Trichloroethylene and pentachlorophenol showed neither DNA damaging potential nor the reverse effect. Acetaldehyde, benzaldehyde, formaldehyde, glyoxal, acrolein, acetylacetone, isophorone, and 3-methyl-2-butanone showed direct or indirect DNA damaging potential. Propionaldehyde, furfurol, and two other aldehydes showed the reverse effect with or without S9 activation. Carvone and n-valeraldehyde showed neither DNA damaging potential nor the reverse effect. On the rec-gram scale, hexachlorocyclopentadiene and hexachloropentadiene showed the strongest DNA damaging potential of the test substances. Seven chlorinated chemicals and aldehydes showed DNA damaging potential although they had been shown to be not mutagenic with the Ames system. (Author's abstract)
W89-13064

PRACTICAL ODOUR NUISANCE GAUGING: TWO CASE STUDIES OF OBJECTIVE ODOUR QUANTIFICATION IN AGRICULTURE AND INDUSTRY.
National Inst. for Water Research, Bellville (South Africa). Cape Regional Lab.
A. J. duToit.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 1077-1087, 1989. 6 fig, 9 tab, 12 ref.

Descriptors: *Odors, *Organoleptic properties, *Pollutant identification, *Testing procedures, *Waste disposal, *Odor control, *Farm wastes, *Industrial wastes, Nuisance, Quantification, Case studies.

The quantification of odor problems associated with liquid and solid agricultural and industrial wastes has long been a controversial subject because of the generally subjective nature of the methods used in evaluating odor-related complaints. To overcome this problem, a scheme was devised which included three separate quantification techniques, researched both locally and abroad. The collective scheme was introduced as the Practical Odor Nuisance Gauging method. This technique has been applied in a number of local odor-related investigations and updated throughout in order to render it more practical and acceptable. Two case studies are included to serve as examples of the application of this scheme. It is shown that odor nuisances were indeed present or were likely to occur at the sites investigated. (Author's abstract)
W89-13083

MULTIPLE TESTING APPROACH FOR HAZARD EVALUATION OF COMPLEX MIXTURES IN THE AQUATIC ENVIRONMENT: THE USE OF DIESEL OIL AS A MODEL.
National Fisheries Contaminant Research Center, Columbia, MO.
B. T. Johnson, and V. I. Romanenko.
Environmental Pollution ENPOEK, Vol. 58, No. 2/3, p 221-235, 1989. 1 fig, 6 tab, 25 ref.

Descriptors: *Risk assessment, *Pollutant mixtures, *Bioindicators, *Water analysis, *Toxicity, *Oil spills, *Model testing, *Water pollution effects, *Aquatic environment, Laboratory equipment, Ponds, Ecological effects, Lake sediments, Water quality, Plant populations, Animal growth, Limnology, Microbiological studies, Testing procedures, Biodegradation, Cleanup.

Traditional single species toxicity tests and multiple component laboratory scaled microcosm assays were combined to assess the toxicological hazard of diesel oil, a model complex mixture, to a model aquatic environment. The immediate impact of diesel oil dosed on a freshwater community was studied in a model pond microcosm over 14 days: a 7-day dosage and a 7-day recovery. A multicomponent laboratory microcosm was designed to monitor the biological effects of diesel oil on water, sediment, plants, and animals. To determine the sensitivity of each part of the community to the contamination and how the community recovered when the oil dissipated, limnological, toxicological, and microbiological variables were considered. Significant occurrences during the spill period were observed: (1) a community production and respiration perturbation indicated by a decrease in dissolved oxygen and redox potential and a concomitant increase in alkalinity and conductivity; (2) marked changes in microbiota of sediments, including increased bacterial productivity and greatly increased numbers of bacterial oil degraders; and (3) column water acutely toxic to two model taxa. Following the simulated cleanup procedure to remove the oil slick, the recovery period was characterized by a return to control values. The term 'toxicosm' is proposed to describe this approach to aquatic toxicological hazard evaluation, and is a valuable tool for screening aquatic contaminants. (Author's abstract)
W89-13156

DETERMINATION OF NITRITE IN DRINKING WATER AND ENVIRONMENTAL SAMPLES BY ION EXCLUSION CHROMATOGRAPHY WITH ELECTROCHEMICAL DETECTION.
Kim and Associates, Wayland, MA.
H. Kim, and Y. Kim.
Analytical Chemistry ANCHAM, Vol. 61, No. 14, p 1485-1489, July 15 1989. 5 fig, 1 tab, 21 ref.

Descriptors: *Water analysis, *Pollutant identification, *Nitrites, *Drinking water, *Chromatography, *Water analysis, Rain, Lakes, Ion exchange, Spectrophotometry, Soil types.

An extremely sensitive determination of nitrite in drinking water (tap water and underground water) and environmental samples (rain, lake water, and soil) was achieved by ion exclusion chromatography (IEC) with electrochemical (EC) detection. Potential interferences in the determination of nitrite by the standard spectrophotometric method or by the ion exchange chromatographic method with either conductivity detection or UV detection were eliminated. The detection limit was 0.1 ppb without preconcentration. No nitrite was observed from tap water or underground drinking water. The recoveries of nitrite added to tap water at 0.02, 0.1, and 1 ppm levels were between 96 and 104.5%. The average coefficient of variation was 4.7%. The recovery results were in good agreement with those obtained by the standard spectrophotometric method. Nitrite concentrations between 0.068 and 0.19 ppm were observed in rain within a week period. A greater variation, between 0.015 and 0.26 ppm, was observed in lake water. Amounts of 19.1 ppm and 0.50 ppm nitrite were observed from fertilized and unfertilized soil, respectively. (Author's abstract)
W89-13193

WATER QUALITY CLASSIFICATION.
Cranfield Inst. of Tech. (England).
W. Lorch.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 84-95, 3 tab, 2 ref.

Descriptors: *Water chemistry, *Water quality, *Classification, *Pollutants, *Chemical properties, Biological properties, Radiochemical analysis, Conductivity, Resistivity, Dissolved solids, Hydrogen ion concentration, Hardness, Water softening, Potable water, Economic aspects.

In this chapter a broad approach was used to classify water quality, taking into account not only purified water and its suitability for use, but also contaminants in the feedwater that influence the process choice, operation, and economics. The physical, chemical, biological, and radiological parameters are examined. Physical parameters include taste, odor, color, turbidity, and colloidal state. Chemical parameters may be specific: conductivity, pH, degree of hardness, acidity on alkalinity, or may be a specific ion, chemical, chemical class or dissolved gas. Parameters indicative of organic and biological pollution may be ascertained by the biochemical or chemical oxygen demand as well as by the presence of bacteria. The measures used to define water quality (expressed in internationally uniform units) included conductivity, resistivity, total dissolved solids, and pH. Other indicators of water characteristics or quality not usually expressed in units, including soft and hard water, permanent and temporary hardness, and potable water, also are defined. (See also W89-13208) (Hammond-PTT)
W89-13212

USE OF DAPHNIA MAGNA AND MYSIDOPSIS ALMYRA TO ASSESS SEDIMENT TOXICITY.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
H. E. Tatem.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 269-281, 5 tab, 28 ref.

Descriptors: *Bioindicators, *Pollutant identification, *Daphnia, *Toxicity, *Water pollution effects, *Bioassay, Crustaceans, Sediment contamination, Lethal limit, Salinity, Estuaries, Metals, Pesticides, Polychlorinated biphenyls, Hydrocarbons.

Daphnia magna have been shown to be useful organisms for screening contaminated sediments for acute toxicity and for determination of sublethal effects on growth. This freshwater species demonstrated acceptable control survival in a 4 parts per thousand (ppt) salinity water and revealed better survival when exposed to the contaminated sediments at a 4 ppt compared to 2 ppt salinity. The data suggest that sediment toxicity tests should be run for at least 120 hr to insure definitive results of either acute toxicity or sublethal effects. Contaminated sediments (four samples containing varying amounts of metals, PCB's, pesticides, and polycyclic aromatic hydrocarbons) held at 4 C for 5 months were shown to be toxic and retained their toxicity for 12 months of storage. The toxicity was generally related to the overall concentration of chemical contaminants in the sediments. The Mysidopsis results were not conclusive but suggest that mysids exposed to the sediments at 14 ppt salinity were not as sensitive to the two most heavily contaminated sediments as the Daphnia. The Daphnia were easily weighed after the sediment tests and can be observed for reproductive effects. The Daphnia weight data supported the toxicity data and can be used to show the relative health of the test animals. Weight data from one experiment showed a harmful effect of one of the sediments that was not apparent from the toxicity data alone. (See also W89-13231) (Lantz-PTT)
W89-13258

INVESTIGATION OF THE STRUCTURAL FEATURES AND INTERACTIONS OF AQUATIC FULVIC ACIDS IN SURFACE AND GROUNDWATER.
North Texas State Univ., Denton. Inst. of Applied Sciences.
For primary bibliographic entry see Field 2K.
W89-13357

DATA ON GROUNDWATER QUALITY, CARSON VALLEY AND TOPAZ LAKE AREAS,

DOUGLAS COUNTY, NEVADA, FOR YEAR ENDING SEPTEMBER 1986.
Geological Survey, Carson City, NV.
For primary bibliographic entry see Field 2F.
W89-13365

ESTIMATING POTENTIAL GROUND AND SURFACE WATER POLLUTION FROM LAND APPLICATION OF POULTRY LITTER-II.
Arkansas Univ., Fayetteville. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W89-13399

INFLUENCE OF DISCHARGE AND URBANIZATION ON THE CONCENTRATION, SPECIATION, AND BIOAVAILABILITY OF TRACE METALS IN THE RARITAN RIVER, NEW JERSEY.
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5B.
W89-13402

5B. Sources Of Pollution

FATE AND TRANSPORT OF BIOLOGICAL AND INORGANIC CONTAMINANTS FROM ON-SITE DISPOSAL OF DOMESTIC WASTEWATER.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
R. B. Reneau, C. Hagedorn, and M. J. Degen.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 135-144, April/June 1989. 105 ref.

Descriptors: *Path of pollutants, *Septic tanks, *Soil disposal fields, *Wastewater disposal, *Fate of pollutants, Waste disposal, Wastewater, Pollutants, Water quality, Domestic wastewater, Environmental quality, Percolation, Research priorities.

The potential impact of selected biological and chemical contaminants present in domestic wastewater on environmental quality is addressed. An on-site wastewater disposal system (OSWDS) is the primary method for domestic waste disposal in sparsely populated areas and in numerous suburban counties. The most common OSWDS is a septic tank with a subsurface soil absorption system that relies on gravity to move wastewater from the residence to the soil with minimal pretreatment of waste before application to the soil. Much of the renovation occurs as the wastewater percolates through the soil prior to reaching ground or surface waters. In 1980, 20.9 million residences applied approximately 140 billion L of domestic wastewater to U.S. soils each day. These numbers emphasize the need for assessing the effect of OSWDS on the quality of the environment. Inefficient use of a soil's renovative capacity (primarily because of poor effluent distribution) can result in extensive travel distances for biological or chemical contaminants as well as hydraulic failure of the OSWDS. The need for further investigation of the potential for water contamination from nitrogenous components and possible mechanisms to reduce the degradation potential of N is addressed. Most studies assume that the dynamics of viral translocation through soil resemble those of fecal bacteria. This assumption may not be correct. Lastly, a critical examination of fate of N, viruses, and fecal bacteria introduced into soils via alternative OSWDS and modified conventional OSWDS should be a priority research initiative. (Author's abstract)
W89-12173

CHEMISTRY OF RAINWATER AND CLOUD WATER AT REMOTE SITES IN ALASKA AND OREGON.
Pacific Northwest Forest and Range Experiment Station, Juneau, AK. Forestry Sciences Lab.
B. T. Bormann, R. F. Tarrant, M. H. McClellan, and T. Savage.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 149-152, April/June 1989. 4 fig, 2 tab, 12 ref.

Descriptors: *Cloud liquid water, *Acid rain, *Air pollution, *Precipitation, *Rainfall, *Alaska, *Oregon, *Chemistry of precipitation, Acidic water, Clouds, Sulfates, Sodium, Chlorides, Nitrates, Ammonium, Magnesium, Potassium, Cycling nutrients, Water pollution effects.

Cloud water and rainwater were examined at remote sites in southeastern Alaska and coastal Oregon using standardized collection and analytical techniques. Cloud water and rainwater were characterized by extremely low concentrations of most ions except SO4(--), Na(+), and Cl(-). Acidity was greater than expected because of organic acids from unknown sources. Concentrations of NO3(-) and NH4(+) were extremely low, especially compared to samples collected similarly in the eastern USA. Rainwater did not differ between Alaska and Oregon except in concentrations of Ca(++), Mg(++), K(+), (Na(+), and Cl(-). Cloud water generally had higher concentrations of ions than rainwater especially in NO3(-), NH4(+), and SO4(--). Ion concentrations were highly variable and non-normally distributed. Sample sizes in future studies should be large (> 40). Cloud water deposition may be very important in terms of potential pollution effects and nutrient cycling in ecosystems with frequent cloud cover. (Author's abstract)
W89-12175

REASONS FOR THE ACCLIMATION FOR 2,4-D BIODEGRADATION IN LAKE WATER.
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
S. Chen, and M. Alexander.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 153-156, April/June 1989. 3 fig, 1 tab, 14 ref. USDA grant 87-CRSR-2-2977.

Descriptors: *Phenoxy acid herbicides, *Fate of pollutants, *Acclimatization, *Biodegradation, *Microbial degradation, *Lakes, *Herbicides, Bacteria, Population dynamics, New York.

A study was undertaken to determine reasons for the occurrence of an acclimation period for the biodegradation of 2,4-dichlorophenoxyacetate (2,4-D) in lake water (from Cayuga or Beebe Lakes, Ithaca, NY). The length of the acclimation period was not affected by removal of cycloheximide and nystatin. The population of 2,4-D-degrading bacteria increased long before 2,4-D loss was detected, and herbicide loss was evident only when the population size was large. The acclimation phase was virtually eliminated if a culture of 2,4-D-utilizing bacteria was added to lake water. A culture of glucose-grown 2,4-D-degrading bacteria metabolized the herbicide in a time interval far shorter than the acclimation phase. The time for acclimation was identical in 14 replicate samples of the same lake water. These data suggest that the length of the acclimation phase is not mainly a result of the time for reduction of grazing pressure on 2,4-D-degrading bacteria, the destruction of antimicrobial compounds, the decomposition of alternative C sources used preferentially to the herbicide, induction of the requisite enzymes, or the appearance of a mutant able to utilize the pesticide. The acclimation for 2,4-D degradation in lake water appears chiefly to reflect the time for a small population of bacteria able to use the compound to become sufficiently large to cause a detectable loss of the chemical. (Author's abstract)
W89-12176

DELIVERY OF NONPOINT-SOURCE PHOSPHORUS FROM CULTIVATED MUCKLANDS TO LAKE ONTARIO.
New York State Dept. of Environmental Conservation, Albany. Bureau of Technical Services and Research.
P. Longabucco, and M. R. Rafferty.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 157-163, April/June 1989. 5 fig, 3 tab, 18 ref. USEPA grant no. ROO5725.

Descriptors: *Nonpoint pollution sources, *Cultivated lands, *Muck soils, *Path of pollutants, *Water pollution sources, *Phosphorus, *Lake Ontario, Fate of pollutants, Cropland, Mucklands, New York, Agricultural watersheds, Runoff.

Cultivated mucklands (Histosols) in western New York State were investigated as a nonpoint source of phosphorus (P) to Lake Ontario. The 70,500 ha Oak Orchard Creek watershed, which contains 3250 ha of heavily fertile muck cropland, was monitored at several sites for a year in order to construct a P budget for the system and determine the mucklands' relative contribution. Runoff during the late winter-early spring period appears to be the most important hydrologic factor in governing annual phosphorus loading from the mucklands, greater than either total precipitation or total runoff for the year. Surplus P leached from muckland soils and delivered to the creek in subsurface runoff accounts for the large dissolved P load measured in the creek at the study site draining the muck cropland. At this stream monitoring location, the mucklands represented only 27% of the drainage area, but were estimated to contribute between 55 and 86% of the annual dissolved reactive P (DRP) load. The load from Oak Orchard Creek to Lake Ontario for the study period was 37,000 kg of the total P (TP), 20,000 kg of which was DRP. Half of the P load was delivered to Lake Ontario in 3 months–March, April, and May--when rain and snowmelt produced significant runoff and high creek flows. A mass balance calculation suggests that as much as 72% of the DRP load and 39% of the TP load entering Lake Ontario from Oak Orchard Creek could be attributed to P losses from the cultivated mucklands located 65 km upstream. (Author's abstract)
W89-12177

ENVIRONMENTAL FATE OF PICLORAM USED FOR ROADSIDE WEED CONTROL.
Montana Univ., Missoula. Gordon Environmental Studies Lab.
V. J. Watson, P. M. Rice, and E. C. Monnig.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 198-205, April/June 1989. 6 tab, 48 ref.

Descriptors: *Highway beautification, *Path of pollutants, *Fate of pollutants, *Herbicides, *Weed control, *Groundwater pollution,, Persistence, Picloram, Rocky Mountains, Photolysis.

The herbicide picloram (4-amino-3,5,6-trichloro-2-pyridine carboxylic acid) was applied to control spotted knapweed (Centaurea maculosa Lam.) in the northern Rockies to determine persistence in soils and vegetation, losses by photodegradation, rainfall induced migration, and potential contamination of surface and groundwater. Two sites were selected to represent best case and worst case conditions (within label restrictions) for on-site retention of picloram in the spring of 1985, and sampled over the following 445-days. In the spring of 1986, 1.12 kg/ha of picloram was applied to both sides of a minimal construction logging road extending 4 km along a stream (102 to 815 cu m) that drains a granitic upper mountain watershed. Of the 17.1 sq km watershed, 0.15% (2.5 ha) was sprayed. Vegetation, soils, surface water, and groundwater near the road were sampled during the 90 days following application. At the valley bottom site, 36, 13, and 10.5% of the picloram applied persisted after 90, 365, and 445 days, respectively. At the mountain watershed site, 78% persisted after 90 days, and picloram was not detected n the surface or groundwaters during the 90 days following application. Depending on the timing of delivery, as little as 1% or less of the application could have been detected after delivery to the stream. Loss by photodegradation during the first 7 days after treatment was important at both sides. (Author's abstract)
W89-12182

ANALYTICAL INVERSE MODELING OF REGIONAL-SCALE TRITIUM WASTE MIGRATION.
Alberta Univ., Edmonton. Dept. of Geology.
A. E. Fryar, and P. A. Domenico.
Journal of Contaminant Hydrology JCOHE6, Vol. 4, No. 2, p 113-125, April 1989. 4 fig, 1 tab, 13 ref.

Descriptors: *Radioactive waste disposal, *Underground waste disposal, *Injection, *Path of pollut-

ants, *Model studies, *Tritium, Radioisotopes, Plumes, Simulation analysis, Statistical analysis.

A regional-scale tritium (3H) plume resulting from waste injection at the Idaho National Engineering Laboratory (INEL) is analyzed using an analytical model. Values of transverse dispersivity, source width, contaminant velocity, and effective source concentration are determined in an independent fashion using the model. Simulations of observed concentrations for the wells analyzed are generally good, with the closest set of parameters yielding matches within 7%. Comparison of the entire simulated plume maps with the actual plume is more qualitative, and indicates a general correspondence in concentration distribution. However, the significance of the simulated plume maps in the near fields is limited, due to source fluctuations and possible poorly connected zones. The reproducibility of the plume, in general, and of concentrations at selected wells with these values is acceptable to good, and the values obtained for transverse dispersivity and contaminant velocity, in particular, are reasonable in light of other regional-scale studies. (Miller-PTT)
W89-12189

EXPERIMENTAL STUDIES OF MASS TRANSPORT IN POROUS MEDIA WITH LOCAL HETEROGENEITIES.
Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.
M. Herr, G. Schafer, and K. Spitz.
Journal of Contaminant Hydrology JCOHE6, Vol. 4, No. 2, p 127-137, April 1989. 6 fig, 2 tab, 24 ref.

Descriptors: *Solute transport, *Model studies, *Path of pollutants, *Tracers, *Permeability, *Groundwater movement, *Porous media, Transport, Heterogeneity, Hydraulic conductivity, Aquifer characteristics.

The effect of local heterogeneities in a porous medium, which are randomly distributed, upon longitudinal spreading in groundwater transport problems is described and related to the permeability ratio between the heterogeneities and the surrounding porous medium. Numerous experimental runs using simplified model aquifers provide a large data base. The measured breakthrough curves indicate the transport behavior of the system. They are compared with the solution of the classical Fickian advection-dispersion equation for the given boundary conditions as well as with a numerical approach to of a modified transport formulation following the dual porosity concept of Coats and Smith. A significant difference in the transport behavior depending on the permeability of the heterogeneities is observed. While mass transport in the model aquifers with local heterogeneities of higher relative permeability remained Fickian, local heterogeneities of lower relative permeability caused a marked trailing and a significant spreading of the tracer. In the dual porosity formulation of transport the transfer coefficient had to be fitted, while the remaining transport parameter could be determined directly. (Author's abstract)
W89-12190

UNCERTAINTY IN A PESTICIDE LEACHING ASSESSMENT FOR HAWAII.
California Univ., Berkeley. Dept. of Plant and Soil Biology.
K. M. Loague, R. S. Yost, R. E. Green, and T. C. Liang.
Journal of Contaminant Hydrology JCOHE6, Vol. 4, No. 2, p 139-161, April 1989. 7 fig, 7 tab, 21 ref.

Descriptors: *Soil water, *Leaching, *Pesticides, *Path of pollutants, *Hawaii, *Model studies, Uncertainty, Soil properties, Urea pesticides, Sorption, Soil types, Soil classification, Soil contamination, Groundwater pollution, Chemical properties.

The predictive uncertainty associated with using the retardation factor (RF) as an index to evaluate pesticide leaching in Hawaii soils when uncertainty exists within the soil and chemical data used to excite the RF model. The analysis takes two separate but ultimately related tacks. First, the uncertainty caused by extrapolating soil properties between taxonomic categories was assessed. Second, the amount of uncertainty for calculated RF values due to data uncertainty is characterized by using first-order uncertainty analysis. The chemical diuron was used to investigate the uncertainty in the RF index caused by uncertainty in the value of sorption coefficient (Koc). The uncertainty in the calculated RF values for diuron were influenced more by the uncertainty in Koc than any of the four soil parameters. Obviously, a good chemical data base is essential from employment of the RF index. Diuron is a relatively immobile chemical in the soils included in this analysis due, in part, to high Koc values. Even so, there is tremendous variability in RF values calculated for differing soil types and classifications. It should be apparent that the use of an index such as RF without consideration for the uncertainty within the soil and chemical data sets can be very misleading. For weakly sorbed chemicals, the uncertainty in parameters contributing to RF is even more critical because the associated high mobility of such chemicals may be important to decisions on chemical use relative to potential for groundwater contaminants. The results indicate that the RF index should only be used with soil information from the lowest taxonomic category and that even then considerable uncertainty will exist in the predicted RF values used to screen and rank chemicals. (Miller-PTT)
W89-12191

SORPTION OF VOLATILE ORGANIC SOLVENTS FROM AQUEOUS SOLUTION ONTO SUBSURFACE SOLIDS.
Illinois State Water Survey Div., Savoy. Hazardous Waste Research and Information Center.
M. D. Piwoni, and P. Banerjee.
Journal of Contaminant Hydrology JCOHE6, Vol. 4, No. 2, p 163-179, April 1989. 4 fig, 5 tab, 24 ref.

Descriptors: *Path of pollutants, *Organic solvents, *Sorption, *Pellicular water, *Subsurface water, Aqueous solution, Solute transport, Saturation zone, Cores, Isotherms, Freundlich equation, Kinetics, Organic carbon, Model studies, Research priorities.

Sorption data for selected organic solvents on several subsurface materials is presented. The goals of the study were to advance the qualitative understanding of sorption of four widely-used organic solvents from aqueous solution onto natural sorbents and to attempt to more quantitatively define a mineral component to that sorption. The ultimate objective was to facilitate a sound basis for predicting transport behavior of dissolved solvents in aquifers. The work first focused on characterizing tetrachloroethene (PCE) sorption on samples obtained primarily from two semi-continuous subsurface cores, and then on sorption of four nonpolar organic solvents on three saturated zone sorbents with low organic carbon content. Results with PCE sorption on subsurface samples indicate that the isotherms can be linearly interpretated up to an equilibrium solution concentration of about 2 mg/L. Above this value, a considerable curvature in the isotherms is observed and application of the Freundlich equation in the interpretation of this data is recommended. Limited data suggest that this threshold concentration may not apply rigorously to very low organic carbon sorbent fraction sorbents and that kinetics associated with sorption to organic carbon may be an influencing factor. Research is needed to more adequately define high concentration limitations of linear sorption models. It is cautioned that applying transport models with linear sorption components in subsurface environments where contaminant concentrations exceed 0.10000 may significantly overestimate sorption. (Miller-PTT)
W89-12192

SORPTION KINETICS OF LOW-MOLECULAR-WEIGHT HYDROPHOBIC ORGANIC COMPOUNDS ON SURFACE-MODIFIED SILICA.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
J. E. Szecsody, and R. C. Bales.
Journal of Contaminant Hydrology JCOHE6, Vol. 4, No. 2, p 181-203, April 1989. 10 fig, 3 tab, 42 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Benzenes, *Sorption, *Kinetics, *Silica, *Organic compounds, Hydrophobicity, Soil properties, Aquifer characteristics.

The rate of sorption and desorption of substituted benzenes was investigated in a series of batch and column experiments using surface-modified silica of known chemical composition. Porous silicas with patchy surface coatings of aliphatic-chain groups (C1, C8, C18) and an aliphatic chain terminating in a phenyl group were prepared; these were less hydrophobic and more easily wetted by water than similar, commercially available, chromatography materials. The surfaces were chosen to represent important functional groups found in soil and aquifer materials. Batch desorption of p-nitrobenzene, nitrotoluene, 1,4-dichlorobenzene, 1,2,4-trichlorobenzene, and 1,2,4,5-tetrachlorobenzene required up to 100 hours to reach equilibrium. Slow sorption and desorption of 1,4-dichlorobenzene in column experiments was evidenced by tailing in breakthrough curves. Results were interpreted considering three possible rate-limiting steps: (1) diffusion through immobile liquid, (2) diffusion through a bound organic phase, and (3) slow chemical binding and release. Diffusion through immobile fluid caused some but not all of the observed slow sorption, as evidenced by experiments with different particles and pore size (toruosity). Desorption on C8(-) and C18(-) modified silicas was at least one order of magnitude faster than on phenyl and C1 surfaces, illustrating the importance of the nature if the surface organic phase. Simple diffusion through the bound organic phase is not adequate explanation for the behavior, due to the small distances. Slow binding and release at strong sites for sorption of 1,4-dichlorobenzene on the phenyl-polymer observed for all modified surfaces were in the range of 0.0001/s to 0.1/s. As equilibrium is reached within hours, slow sorption is observed at the laboratory scale, but local equilibrium applies to most field situations. (Author's abstract)
W89-12193

EFFECT OF HETEROGENEITY ON LARGE SCALE SOLUTE TRANSPORT IN THE UNSATURATED ZONE.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics Engineering.
For primary bibliographic entry see Field 2F.
W89-12197

EPIDEMIOLOGICAL SIGNIFICANCE OF MICROBIOLOGICAL POLLUTION CRITERIA FOR RIVER RECREATIONAL WATERS.
Centre Alpin de Recherche Epidemiologique et de Prevention Sanitaire, Grenoble (France).
J. P. Ferley, D. Zmirou, F. Balducci, B. Baleux, and P. Fera.
International Journal of Epidemiology IJEPBF, Vol. 18, No. 1, p 198-204, March 1989. 3 fig, 6 tab.

Descriptors: *Microorganisms, *Water quality standards, *Swimming, *Epidemiology, *Human diseases, *Rivers, Microbiological studies, Recreation, Tourism, Bacterial analysis.

A retrospective follow-up study was conducted during the summer of 1986 in the French Ardeche basin in order to assess the relationship between swimming-related morbidity and the bacteriological quality of the recreational water. 5737 tourists in eight holiday camps were questioned as to the occurrence of illness and thier bathing habits during the week preceding the interviews. The rate-ratio (RR) contrasting swimmers and non-swimmers for total morbidity is 2.1(1.8-2.4) = 95% confidence interval. Gastrointestinal illness is the major type of morbidity and differs significantly between the two groups (RR = 2.4(1.9-3.0) for total gastrointestinal cases; RR = 2.3(1.7-3.2) for objective gastrointestinal cases. Fecal streptococci (FS) are best correlated to gastrointestinal morbidity, using direct linear regression models. Fecal coliforms (FC) are not as good predictors of the risk. The concentration of fecal streptococci, above which the objective gastrointestinal morbidity among bathers is significantly greater than

among non-bathers, is 20 FS/100 ml. Swimmers suffer skin ailments much more frequently than non-swimmers (RR + 3.7(2.4-5.7); although the relationship may be artifactual, this type of morbidity is well correlated with the concentration of fecal coliforms, aeromonas and pseudomonas. This epidemiological data can serve as a base for microbiological standards for river recreational waters dependent on what might be considered as an acceptable risk. (Author's abstract)
W89-12199

NITRATE EXPOSURE FROM DRINKING WATER AND DIET IN A DANISH RURAL POPULATION.
Landsforeningen til Kraeftens Bekaempelse, Copenhagen (Denmark).
H. Moller, J. Landt, P. Jansen, E. Pedersen, and H. Autrup.
International Journal of Epidemiology IJEPBF, Vol. 18, No. 1, p 206-212, March 1989. 3 fig, 3 tab, 19 ref.

Descriptors: *Denmark, *Rural areas, *Path of pollutants, *Nitrates, *Drinking water, *Diets, Rural populations, Population exposure, Comparison studies.

Increasing levels of nitrate (NO3(-)) in drinking water in Denmark is of concern due to the possibility of an associated increase in long-term exposure to endogeneously formed N-nitroso compounds. Using a duplicate portion technique in combination with a qualitative description of diet and other background variables, the total nitrate intake in a Danish rural population and the contribution of drinking water to the total nitrate exposure is estimated. People drinking nitrate-free water have an intake of 37 mg NO3(-) per day. At 47 mg NO3(-) per litre, the exposure is increased to 89 mg, about 60% of which originates from the water. At 84 mg NO3(-) per litre, the daily exposure is 123 mg, 70% of which orginates from the drinking water. These crude comparisons between three groups of people are supplemented with quantitative modeling of nitrate in this population. Using nitrate in overnight urine samples to quantify exposure is less accurate than the duplicate dietary portion technique and tends to underestimate the contribution of water-derived nitrate to total nitrate intake. (Author's abstract)
W89-12200

MANAGEMENT OF WATER QUALITY IN THE GREAT BARRIER REEF MARINE PARK.
Great Barrier Reef Marine Park Authority, Townsville (Australia).
For primary bibliographic entry see Field 5G.
W89-12206

IMPACT OF MARINAS ON WATER QUALITY.
Queensland Dept. of Environment, Conservation and Tourism, Brisbane (Australia). Div. of Water Quality.
P. J. T. McMahon.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 39-43, 1989. 2 tab, 6 ref.

Descriptors: *Marinas, *Water pollution sources, *Heavy metals, *Recreation, *Hydrocarbons, *Sediments, *Australia, Water quality control, Lead, Copper, Zinc, Mercury, Organotin compounds, Antifouling compounds, Oysters.

Four salt-water marinas in Queensland, Australia, were studied in an attempt to ascertain their impact on water quality. Analyses of water, sediment and biological samples (oysters) showed no evidence of dissolved oxygen depletion or nutrient enrichment of the water column and no nutrient enrichment, organic pollution, toxic pollution or bacterial degradation of the sediments. Analyses of organotin compounds from antifouling residues were inconclusive due to problems in interpreting the results and comparing them with overseas results. The major impact was found to be the build-up of heavy metals (Pb, Cu, Zn, Hg) and petroleum hydrocarbons. The accumulated levels of these, however, were similar to those in other areas affected by human activity and were not indicative of significant water pollution. Nevertheless, water quality within marinas can be improved and guidelines for marina construction were developed based on the results of this study and a literature review. (Author's abstract)
W89-12207

WATER QUALITY IN RESIDENTIAL TIDAL CANALS.
Queensland Dept. of Environment, Conservation and Tourism, Brisbane (Australia). Div. of Water Quality.
A. J. Moss.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 53-58, 1989. 1 fig, 1 tab, 12 ref.

Descriptors: *Water pollution control, *Tidewater, *Water quality, *Canals, *Canal design, *Australia, Stratification, Flushing, Residential development.

Monitoring of water quality in residential tidal canals in Queensland has been carried out since 1974. Some recent data from four separate canal systems and their source waters is presented. Source water quality was generally good and this high quality was maintained in surface waters throughout these systems. Stratification of the water column in poorly flushed canal branches led to periodic deterioration in bottom water quality but this never resulted in significant management problems. Based on the Queensland data and on data from other Australian and overseas canal systems, conclusions are drawn about significant factors affecting canal water quality. These include flushing rates, source quality, polluting inputs, freshwater inflows and depth. Possible objectives for canal water quality include: (1) canals should not adversely affect the quality of their source waters; (2) canal water quality should meet residents' requirements; (3) canals should be designed to optimize conditions for the establishment of a healthy ecosystem while recognizing the need for some compromise with other interests. (Author's abstract)
W89-12209

CATALYSED FORMATION OF CHLORINATED ORGANIC MATERIALS IN WATERS.
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. Barnes, P. A. Fitzgerald, and H. B. Swan.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 59-63, 1989. 6 tab, 11 ref.

Descriptors: *Water pollution sources, *Water treatment, *Organic compounds, *Chlorinated hydrocarbons, *Chlorination, *Trihalomethanes, *Swimming pools, Copper, Humic acids, Public health, Potable water.

Chlorinated organics, in particular trihalomethanes, are generally considered to be toxic if ingested. Several factors such as precursors, pH, temperature and chlorine dose are known to affect the final concentration of these products. There is evidence of significant levels of trihalomethanes in intensively used recreational waters when chlorinated. Ingestion of 50 mL of water is postulated for swimmers. Cu, which is frequently used as an algacide, catalyses trihahomethane formation. At a Cu concentration of 1 mg/L, in the presence of 1:1 ratios of humic acid:chlorine, 74% as much chloroform was produced in 24 h at 2 mg/L of humic acid and 3.7 times as much at 10 mg/L than in the absence of Cu. In addition, water used for recreational purposes will have increased precursor concentrations. These factors in the formation of chlorinated organic materials could restrict the intensive use of some water bodies, especially where some or all of the water is destined for potable use. (Author's abstract)
W89-12210

BACTERIOLOGICAL QUALITY OF TIDAL BATHING WATERS IN SYDNEY (AUSTRALIA).
New South Wales Dept. of Health, Lidcombe (Australia). Div. of Analytical Labs.
A. G. Bernard.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 65-69, 1989. 2 fig, 4 tab, 4 ref.

Descriptors: *Bacterial analysis, *Australia, *Recreation, *Swimming, *Water quality, *Sewage bacteria, *Water pollution sources, *Public health, Coliforms, Salmonella, Streptococcus, Pseudomonas, Pollutant identification, Wastewater disposal, Tidewater.

The bacteriological quality of Sydney's tidal bathing waters has been regularly monitored during summer months over the past decade. Tests for fecal coliforms have been supplemented in the last 5 years with tests for fecal streptococci, Salmonella and Pseudomonas aeruginosa. Results show that higher levels of fecal coliforms are associated with increased concentrations of fecal streptococci and P. aeruginosa and an increase in the incidence of Salmonella. The extent of bacteriological contamination of a bathing water is influenced by distance from the point of pollution discharge and the occurrence of rainfall. The availability of detailed survey data enables more effective recognition of incidents of significant pollution and the likelihood of an increased public health risk. (Author's abstract)
W89-12211

DISPERSION OF SEWAGE WASTES IN NEARSHORE COASTAL WATERS: APPLICABILITY OF WATER QUALITY CRITERIA.
Port Elizabeth Univ. (South Africa). Dept. of Oceanography.
D. A. Lord, W. O. K. Grabow, and M. J. Roberts.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 77-81, 1989. 1 fig, 1 tab, 13 ref.

Descriptors: *Wastewater outfall, *Wastewater disposal, *Coastal waters, *Water quality standards, *Water pollution sources, *Sewage bacteria, *Viruses, *Public health, Epidemiology, Shellfish, Recreation, Water analysis, Bacterial analysis.

Deepwater outfalls can be satisfactorily designed to ensure rapid dilution of sewage wastes, and allow for conventional water quality criteria which prescribe low bacterial levels in areas used for recreational purposes and shellfish harvesting, to be achieved. However, surface shoreline discharges of similar wastes dissipate far less readily, and normally result in shoreline bacterial levels far in excess of desirable criteria. The absolute assessment of water quality in suspect areas should ideally include viral counts as well as epidemiological information on infections of persons exposed to contaminated seawater or seafood. (Author's abstract)
W89-12213

UREASE AS A POSSIBLE TRACER FOR SEWAGE EFFLUENT PLUMES.
Queensland Dept. of Environment, Conservation and Tourism, Brisbane (Australia). Div. of Water Quality.
For primary bibliographic entry see Field 5A.
W89-12215

WATER QUALITY, PHOSPHORUS BUDGETS AND MANAGEMENT OF DUNE LAKES USED FOR RECREATION IN QUEENSLAND (AUSTRALIA).
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
A. H. Arthington, G. J. Miller, and P. M. Outridge.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 111-118, 1989. 2 fig, 3 tab, 23 ref.

Descriptors: *Water pollution sources, *Lakes, *Dune lakes, *Recreation, *Water quality management, *Water quality, *Eutrophication, *Australia, Pollution load, Phosphorus, Mathematical models.

The water quality and trophic status of two Queensland dune lakes are compared in the context of assessing the impacts of recreational use and other human activities. Lake Freshwater, Cooloola, has a mean total phosphorus concentration of 12.1 +or-3.3 microgram/L and is approaching

mesotrophic status, whereas Blue Lagoon, Moreton Island, is oligotrophic. Natural loadings of total phosphorus, ranging from 0.2 to 0.35 g/sq m/yr, are consistent with the progression of Lake Freshwater from oligotrophic to mesotrophic status. The phosphorus loadings predicted by Vollenweider's one-compartment model, for two values of mean lake depth, also indicate that Lake Freshwater is tending towards eutrophic conditions. Potential threats to changes in nutrient loadings to the sand dune lake ecosystems of southeastern Queensland may originate from a variety of natural and human-derived sources. These include recreational uses, sand-mining, septic tanks or sullage waters, forestry, water extraction, clearing, feral animals, bushfires and drought. All of these factors may alter nutrient inputs and/or hydrologic parameters which strongly influence actual loadings. (Sand-PTT)
W89-12218

FACTORS AFFECTING BIOCONCENTRATION OF TRACE ORGANIC CONTAMINATION IN WATERS.
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
D. W. Hawker, and D. W. Connell.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 147-150, 1989. 2 fig, 17 ref.

Descriptors: *Path of pollutants, *Biological magnification, *Bioaccumulation, *Biodegradation, *Organic compounds, *Fate of pollutants, Octanol-water partition coefficient, Solubility, Ionization.

The influence of some important biological and physicochemical factors on the bioconcentration of hydrophobic organic chemicals is outlined. For non-ionizable, persistent compounds the bioconcentration factor can be related to a compound's octanol/water partition coefficient, aqueous solubility and molecular weight, while the lipid content of an organism also affects the bioconcentration potential of these compounds. Chemicals capable of being biodegraded do not bioconcentrate as much as anticipated on the basis of these relationships; for chemicals capable of ionization, such relationships may be inappropriate due to possible alternate bioconcentration pathways. (Sand-PTT)
W89-12223

POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN SEDIMENTS OF THE BRISBANE RIVER (AUSTRALIA): PRELIMINARY RESULTS.
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
S. I. Kayal, and D. W. Connell.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 161-165, 1989. 1 fig, 2 tab, 10 ref.

Descriptors: *Water pollution sources, *Polycyclic aromatic hydrocarbons, *Sediments, *Path of pollutants, *Municipal wastewater, *Industrial wastewater, *Australia, Carcinogens, Brisbane River estuary, Wastewater outfall, Petroleum products.

Results of the analysis of 23 composite sediment samples revealed that PAHs are widely distributed in the Brisbane River estuary. Mean concentrations for individual compounds on a dry weight basis ranged from 0.03 microgram/g for dibenzo(ah)anthracene to 2.34 microgram/g for fluoranthene. Observed PAH assemblages were rich in compounds having pyrolytic origins. However, the presence of petroleum derived compounds was indicative of the importance of petroleum as a PAH source in the estuary. Petroleum refineries, a coal loading terminal and a major treated sewage outfall located at the mouth were not indicated as major contributing sources of PAH pollution in the estuary. (Author's abstract)
W89-12224

ASSESSMENT OF THE IMPACT OF LAND USE ON RECREATIONAL WATERS USING MATHEMATICAL MODELS.
Queensland Dept. of Environment, Conservation and Tourism, Brisbane (Australia). Div. of Water Quality.
For primary bibliographic entry see Field 4C.
W89-12234

WATER QUALITY AND MANAGEMENT IN THE GREAT BARRIER REEF MARINE PARK.
Great Barrier Reef Marine Park Authority, Townsville (Australia).
C. L. Baldwin.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 267-272, 1989. 1 tab, 9 ref.

Descriptors: *Water pollution sources, *Water quality management, *Tourism, *Recreation, *Nutrients, *Pollutants, *Corals, *Wastewater pollution, Great Barrier Reef Marine Park, Australia.

Use of the Great Barrier Reef Region for tourism, the economic value of Reef tourism to Queensland, and the value placed by society on natural settings has been increasing rapidly during the 1980s. The Great Barrier Reef Marine Park Authority has the role of providing for reasonable use of this valuable resource. The concern for reef water quality is discussed in terms of enhanced nutrient levels in the inshore Reef and the low tolerance of corals to nutrients. Findings of a recent Workshop on Nutrients in the Great Barrier Reef Region indicate that inshore waters appear to have enhanced nutrient levels and in localized areas may be reaching the threshold with respect to coral degradation. Pollutants which may affect coral reefs include herbicides and pesticides, antifouling paints, petroleum hydrocarbons, hyposaline (freshwater from effluent, rainwater runoff, rivers) and hypersaline (from desalination plants) water, thermal discharges, and heavy metals. The Authority's role is to ensure information exchange, appropriate research, and management in the area of water quality management and tourism. (Sand-PTT)
W89-12241

CONSUMPTION OF INORGANIC PHOSPHORUS BY DIFFERENT DIMENSIONAL GROUPS OF MICROPLANKTON IN SEVASTOPOL BAY (POGLOSHCHENIE NEORGANICHESKOGO FOSFORA RAZLICHNYMI RAZMERNYMI GRUPPAMI MIKROPLANKTONA V SEVASTOPOL'SKOI BUKHTE).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
For primary bibliographic entry see Field 2L.
W89-12253

INFLUENCE OF UREA TOP DRESSING OF FOREST WATER CATCHMENT AREAS ON THE BIOLOGICAL SUFFICIENCY AND WATER QUALITY IN MOUNTAIN STREAMS. I. HYDROCHEMICAL AND SAPROBIOLOGICAL ASSESSMENT (VLIYANIE NA TORENETO S UREYA NA GORSKI VODOSBORI V'RKHU BIOLOGICHNATA P'LNOTSENNOST I KACHESTVATA NA VODITE V PLANINSKI POTOTSI. I. KHIDROKHIMICHNA I SAPROBIOLOGICHNA OTSENKA) (IN BULGARIAN).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
Y. I. Uzunov, S. G. Kovachev, and V. K. Nenova.
Hydrobiologia HYDRB8, Vol. 27, p 22-35, 1986. 10 fig, 21 ref. English summary.

Descriptors: *Water pollution sources, *Nonpoint pollution sources, *Water pollution effects, *Fertilizers, *Forest watersheds, Mountain streams, Yadenitsa River, Ureas, Agricultural chemicals, Nitrates, Nitrites, Nitrogen compounds, Ammonium.

Mountain streams of the tributary system of the river Yadenitsa were studied between April 1982--October 1983 under conditions of experimental aerial top dressing with urea on forest water catchment areas (600 kg/ha). The changes in water quality have been described and assessed using chemical and saprobiological indicators. No significant relationship was proven between fertilization and the oxygen group of indicators (oxygen content and saturation, permanganate oxidation, biological oxygen demand (BOD), the dynamics of which depends on the thermal and hydrological regimes, on the type of stream flow, etc. The saprobic state of the tributary system under study is characterized as being xenosaprobic (mean index Sr=83) and remained practically unchanged during the investigation. The level of phosphates and the pH was not affected significantly. The average ammonium concentration in the experimental area was 2.7 times larger than that in the control area. An increase in this effect was observed following repeated top dressing: 20 days after the experiment the ammonium level exceeded the norm by about 8 times. The nitrite and nitrate dynamics are qualitatively similar to those of ammonium. While the average quantities are far below the norm, their level in the experimental streams is higher than in the respective controls. A considerable lowering of the fertilizing norms is recommended with a view to decreasing (1) the resistant quantities of ammonium in the soil, and (2) the related nitrate and nitrite levels in the surface water. The results indicate that urea top dressing of forest water catchment areas has a specific nonpoint impact on quality of the running water in the tributary system under study. (Author's abstract)
W89-12256

DYNAMICS OF THE QUANTITATIVE BACTERIOLOGICAL CHARACTERISTICS OF WATER QUALITY IN MESTA RIVER IN CONNECTION WITH ITS SELF-PURIFICATION (DINAMIKA KOLICHESTVENNYKH MIKROBIOLOGICHES KIKH POKAZATELEI KACHESTVA VODY PEKI MESTA VSVIYAZI C EYO SAMOOHISHCLENIEN) (IN BULGARIAN).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
S. M. Naumova.
Hydrobiologia HYDRB8, Vol. 25, p 17-23, 1986. 2 fig, 4 tab, 22 ref. English summary.

Descriptors: *Path of pollutants, *Bulgaria, *Mesta River, *Self-purification, *Bacterial analysis, *Decomposing organic matter, Saprophytic bacteria, Seasonal variation, Water quality, Water temperature, Chemical oxygen demand, Biodegradation.

The water quality in the polluted Mesta River in Bulgaria was determined by means of chemical, saprobiological and bacteriological indicators during the self-purification process. This process was intensive in summer and slightly impeded by the low temperature in winter; yet in both cases the water quality generally recovered at the end of the studied stretch of the Mesta, as compared to the unpolluted part. A strong and highly significant linear correlation was established between the basic bacteriological characteristics (total count of bacteria, numbers of oligocarbophiles, carbophiles, and spores) and the bacteriological indices with the water temperature, oxygen content and saturation, and COD (permanganate), as well as with the Rothschein's saprobiological index (Sr). The saprobity of the river water could be determined by quantitative bacteriological analysis during saprobic conditions caused by an influx of biodegradable organic matter. (Author's abstract)
W89-12258

POLLUTION AND EUTROPHICATION OF THE UPPER REACHES OF THE SAZAVA RIVER (CZECHOSLOVAKIA).
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia).
V. Sladecke, and J. Pickova.
Hydrobiologia HYDRB8, Vol. 26, p 3-14, November 1985. 1 fig, 9 tab, 41 ref.

Descriptors: *Water pollution sources, *Czechoslovakia, *Water pollution effects, *Eutrophication, *Sazava River, *Trophic level, Municipal wastewater, Industrial wastewater, Self-purification, Food-processing wastes, Chemical properties, Bacterial analysis, Coliforms, Wastewater pollution, Periphyton, Czechoslovakia.

Six locations in the upper reaches of the Sazava River in Czechoslovakia, a river polluted mainly by municipal sewage from towns, some industrial enterprises, and especially by potato starch wastes

in autumn and winter, were sampled from September 1982 to April 1983. Chemical analyses revealed an increase of inorganic as well as organic matter entering the river and causing both pollution and eutrophication. Bacteriological analyses showed that fecal contamination was very high, due to the absence of purification plants, but it decreased in the course of self-purification. Saprobic indices of the flowing water (nannoplankton) and the periphyton are tabulated and indicate that alpha-meso-saprobic conditions prevailed. The trophic potential, which indicates how much algal biomass can develop on the basis of nutrients present in the water, showed a slight variation between mesotrophic and eutrophic conditions. (Author's abstract)
W89-12261

TRENDS IN CHANGES OF THE HYDROBIOLOGICAL AND SAPROBIOLOGICAL STATE OF THE TUNDZA RIVER. II. MAY-NOVEMBER 1981 (TENDENTSII V IZMENENIYATA NA KHIDROBIOLOGICHNOTO SAPROBIOLOGICHNOTO S'STOYANIE NA REKA TUNDZHA. II MAII I NOEMBRII 1981) (IN BULGARIAN).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
I. J. Janeva, and B. K. Russev.
Hydrobiologia HYDRB8, Vol. 26, p 15-36, 1985. 2 fig, 2 tab, 18 ref. English summary.

Descriptors: *Eutrophication, *Pollution index, *Pollution load, *Bioindicators, *Tundza River, *Dam effects, *Water pollution effects, *Species diversity, *Bulgaria, Benthic fauna, Insects, Amphipods, Midges, Oligochaetes, Caddisflies, Water quality.

Thirty samples were taken from 15 stations along the Tundza River, Bulgaria during May to November 1981. Hydrochemical parameters, the saprobiological index, and the structure of benthic communities (species variety, evenness and coefficient of domination), were used to establish the general conditions of the river. From a quantitative point of view Ephemeroptera (21.19%) followed by class Oligochaeta (19.20%), order Amphipoda (18.32%), family Chironomidae (14.30%), order Trichoptera (10.55%) etc. were of greatest significance for the Tundza river in 1981. The following patterns were established in the percentage ratio between the different benthic groups depending on changes in the saprobic state: representatives of the order Ephemeroptera prevailed when the values of the saprobic index (Sr) were 37.57-71.30; Chironomdae-Sr, 36.84-73.61, Trichoptera-Sr, 45.03-48.10; Amphipoda-Sr, 31.15-46.90; Oligocheata-Sr, 18.04-40.39. An increase in Sr values was usually accompanied by an increase in the numbers of Ephemeroptera and a decrease in Oligochaeta. Domination of the species shows that under optimum conditions the species reach optimal numbers which indicates that the greatest significance of the respective bioindicator or its dominating (optimal) distribution is as an index to the pollution load of a respective zone. The relationship proves the mutual interplay between composition and structure of bottom communities and the quality of water, i.e. the interrelationship between bottom communities and their environment. The G. Dimitrov and Zrebcevo Dams have a destructive effect on benthic communities, even though they improve the quality of water. This is due to specific conditions in dams in general and the frequent changes in the regulation of their water flow. A comparison of the saprobic index for the Tundza River in 1955, in 1966-1967, and in May 1981 shows that pollution of the river is gradually but firmly on the increase. (Author's abstract)
W89-12262

CHARACTERISTICS OF GROUNDWATERS IN THE L. I. BREZNEV METALLURGICAL WORKS, BASED ON MICROBIOLOGICAL INDICES (KHARAKTERISTIKA NA GRUNTOVITE VODI OT RAIONA NA SMK ' L.I. BREZHNEV' VIZ OSNOVA NA MIKROBIOLOGICHUI POKAZATELI) (IN BULGARIAN).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
D. A. Bukureshtliev.
Hydrobiologia HYDRB8, Vol. 26, p 59-69, 1985. 2 fig, 2 tab, 6 ref. English summary.

Descriptors: *Water pollution sources, *Pollutant identification, *Groundwater pollution, *Coliforms, *Bacterial analysis, Septic tanks, Pollution load, Seasonal variation, Self-purification.

Nine groundwater sources representative of the water table of settlements around the L. I. Breznev Metallurgical Works in Bulgaria over an interval of 2 months--from March to October 1982. The total number of microorganisms, index of Rasumov, morphological index, general coliform titer and microbe numbers at 22 C and 37 C were determined. Differentiated coliform titers, enterococci and perfringence titers were established by standard methods in March and May. The total number of microorganisms varied from 1-9 to 100s/cu cm. The total coliform titer varied considerably from 200 times to 1000 times in the different groundwater sources sampled and points to local fecal pollution. A general organic load was established by the data; in some instances direct, indirect, fresh and earlier fecal pollution. The water at one station is more susceptible to fecal pollution due the rather shallow water table and the proximity of a septic pit. The similar values for pollution data in March and October, established for most water sources, suggest a seasonal balance between pollution and self-purification. (Author's abstract)
W89-12264

CHEMICAL COMPOSITION OF WATER AND PLANKTON IN A COOLANT-RESERVOIR (ATOMIC-ENERGY) IN SOUTHERN UKRAINE (KHIMICHESKII SOSTAV VODY I PLANKTON VODOEMA-OKHLADITELIA IUZHNO-UKRAINSKII AES).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
O. A. Sergeeva, R. A. Kalinichenko, S. I. Kosheleva, and L. G. Lenchina.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 6, p 9-14, 1988. 3 tab, 16 ref. English summary.

Descriptors: *Water pollution sources, *Water chemistry, *Thermal pollution, *Nuclear powerplants, *Ukraine, *Plankton, Water temperature, Chemical composition, Cooling water.

The chemical composition of water in the coolant water body of an atomic energy station in the Ukraine was determined mainly by the physiographical conditions of the region. No essential changes were found in the ion-salt water composition, in the gas regime, in the concentration level of biogenic or organic matter as a result of the discharge of heated water. Considerable variations in the qualitative indices of plankton development were marked both before and after the start-up of the atomic station. A rise of the discharge water temperature up to 40 degrees resulted in alterations in the planktonic associations. (Author's abstract)
W89-12271

CHARACTERISTICS IN THE FORMATION OF MICROMETAL ELEMENTS IN MUSSELS UNDER AQUACULTURE CONDITIONS (NEKOTOYE OSOBENNOSTI FORMIROVANIYA MIKROELEMENTOGO SOSTAVA MOLLYUSKOV V YSLOVIYAKH AKVAKUL'TURY).
Moscow State Univ. (USSR).
E. S. Pavlova.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 2, p 64-67, 1988. 3 tab, 8 ref. English summary.

Descriptors: *Mussels, *Metals, *Tissue analysis, *Mollusks, Black Sea, Aquaculture, Iron, Manganese, Copper Nickel, Cobalt, Chromium, Strontium, Lead, Cadmium, Pollutant identification.

The concentration of nine metals (iron, manganese, copper, nickel, cobalt, chromium, strontium, lead, and cadmium) was determined in the soft tissues of cultivated mussels from two regions of the Black Sea. Metal concentration in young mollusks was almost the same or higher than in the older mussels. There was a high concentration of a number of metals in mollusks sampled at the end of spring. (Author's abstract)
W89-12282

DENITRIFICATION AND NITROGEN FIXATION IN THE SEDIMENTS OF VOSTOK BAY OF THE SEA OF JAPAN (DENITRIFIKATSIIA I AZOTFIKSATSIIA B OSADKAKH ZALIVA VOSTOK IAPONSKOGO MORIA).
Akademiya Nauk SSSR, Vladivostok. Inst. Biologii Morya.
V. S. Odintsov, O. A. Dultseva, N. P. Lvov, and M. V. Propp.
Biologiia Moria BIMOD4, No 3, p 30-37, 1988. 4 fig, 1 tab, 9 ref. English summary.

Descriptors: *USSR, *Nitrates, *Vostok Bay, *Denitrification, Nitrogen fixing bacteria, Sediments, Bacteria, Mathematical models, Model studies.

Denitrification potential, the number of denitrifying bacteria and nitrogen fixing activity in the sediments, was measured in two sections of Vostok Bay in the Sea of Japan. The number of denitrifying bacteria and denitrification potential were higher at the site where the anthropogenic effects were greater. At this site, nitrogen fixing activity was less dependent on the concentration of exogenous nitrate than at the other site. There is a positive correlation between denitrification rate and exogenous nitrate concentration. Mathematical models are presented that describe the dependence of denitrification and nitrogen fixation on nitrate concentration. (Author's abstract)
W89-12285

ZOOBENTHOS OF THE RIVER VIT. II. DYNAMICS OF THE BENTHIC ZOOCOENOSES UNDER ANTHROPOGENIC INFLUENCE (ZOOBENTOS'T NA R. VIT. II. IZMENENIE NA ZOOBENTOSNITE ZOOTSENOZI POD ANTROPOGENNO VLIIANIE).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 5C.
W89-12286

TRENDS IN THE CHANGES OF THE SAPROBIOLOGICAL CONDITION OF THE RIVER BELI LOM AND STRUCTURAL CHARACTERISTICS OF ITS BENTHIC ZOOCOENOSES DURING THE 1982-1984 PERIOD (TENDENTSII V IZMENENIIATA NA SAPROBIOLOGICHNOTO S'STOIANIE NA R. BELI LOM I STRUKTURNA KHARAKTERISTIKA NA BENTOSNITE I ZOOTSENOZI PREZ 1982-1984 YA).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 5C.
W89-12287

COMPARATIVE STRATEGIES OF HEAVY METAL ACCUMULATION BY CRUSTACEANS: ZINC, COPPER AND CADMIUM IN A DECAPOD, AN AMPHIPOD AND A BARNACLE.
Queen Mary Coll., London (England). School of Biological Sciences.
P. S. Rainbow, and S. L. White.
Hydrobiologia HYDRB8, Vol. 174, No. 3, p 245-262, April 22, 1989. 14 fig, 12 tab, 33 ref. NERC grant GR3/5256.

Descriptors: *Crustaceans, *Decapods, *Amphipods, *Barnacles, *Heavy metals, *Zinc, *Copper, *Cadmium, *Bioaccumulation, *Path of pollutants, Comparison studies, Shrimp, Excretion.

This study investigated the comparative strategies of accumulation under standardized laboratory conditions of the essential metals Zn and Cu, and the non-essential metal Cd by three crustaceans: the decapod Palaemon elegans, the amphipod Echinogammarus pirloti and the barnacle Elminius modestus. P. elegans regulated body Zn concentrations to a constant level (about 79 microgram Zn/g) over a wide range of dissolved metal availabilities until regulation breaks down at high Zn avail-

abilities and net accumulation begins. E. pirloti accumulates Zn at all dissolved Zn concentrations but at a low net rate such that the accumulation strategy approaches that of regulation. E. modestus accumulates Zn to high body concentrations with no significant excretion of accumulated Zn. P. elegans similarly regulates body Cu concentrations to a constant level (about 129 microgram Cu/g) over a range of dissolved Cu availabilities until regulation breaks down at high Cu concentrations. Both E. pirloti and E. modestus accumulate Cu at all dissolved Cu exposures with no evidence of regulation. All three species accumulate Cd at all dissolved concentrations without regulation. Heavy metal accumulation strategies therefore vary between crustacean taxa and between metals. Uptake rates for Zn and Cd were estimated for the three species and can be interpreted in terms of cuticle permeability and way of life of each crustacean. Examination of these uptake rates provides an insight into possible reasons behind the adoption of particular metal accumulation strategies. (Author's abstract)
W89-12308

RADON IN GROUND WATER SUPPLIES.
K. L. Dixon, and R. G. Lee.
Water Well Journal WWJOA9, Vol. 43, No. 6, p 44-49, June 1989. 6 tab, 7 ref.

Descriptors: *Radioactivity, *Radon, *Groundwater pollution, *Wells, *Drinking water, *Water treatment, Activated carbon, Aeration, Aquifers, Geologic formations.

In September 1986, the System Water Quality Department of the American Water Works Service Co. began conducting a radon survey that was designed to determine the levels of radon in American ground water supplies, and to assess the radon removal efficiency of existing treatment processes such as filtration through granular activated carbon (GAC) and various forms of aeration. The survey found that companies in the northeastern part of the country experienced the highest levels of radon in ground water supplies. The highest concentrations were in individual wells in New Hampshire, Maryland, Connecticut, Rhode Island, New Jersey, Pennsylvania and California. The analytical results from the occurrence phase of the survey seemed to correlate well with the known geology of the aquifer materials from which samples of ground water were drawn. The highest levels were associated with formations of uranium-bearing granitic rocks. GAC can effectively reduce radon concentrations in drinking water supplies to very low levels. However, the amount of contact time within the carbon bed required to do so would be prohibitive to many water utilities from an operational and economic standpoint. Further, disposal of the spent GAC as a low-level radioactive waste (lead-210 content) may be required. Aeration is very effective in the removal of radon from drinking water. Packed tower aerators achieved >95% reduction in radon concentrations and conventional cascading tray aerators achieved >75% reduction in radon concentrations. (Sand-PTT)
W89-12309

DETERMINATION OF DENITRIFICATION ACTIVITY IN BOTTOM SEDIMENT OF LAKE TEGANUMA AND ITS ROLE IN SELFPURIFICATION OF THE LAKE.
Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Environmental Science and Conservation.
For primary bibliographic entry see Field 2H.
W89-12324

ENDOGENOUS NITROSATION IN RELATION TO NITRATE EXPOSURE FROM DRINKING WATER AND DIET IN A DANISH RURAL POPULATION.
Landsforeningen til Kraeftens Bekaempelse, Copenhagen (Denmark).
For primary bibliographic entry see Field 5F.
W89-12368

DEVELOPMENT AND MONTE CARLO ANALYSIS OF AN OYSTER BIOACCUMULATION MODEL APPLIED TO BIOMONITORING DATA.
Versar, Inc., Columbia, MD.
K. A. Rose, R. I. McLean, and J. K. Summers.
Ecological Modelling ECMODT, Vol. 45, No. 2, p 111-132, April 1989. 5 fig, 3 tab, 20 ref. Maryland Power Plant Research Program contracts PR-86-0707 and PR-86-043-01(87).

Descriptors: *Radioactive wastes, *Path of pollutants, *Bioindicators, *Nuclear powerplants, *Model studies, *Monte Carlo method, *Oysters, *Bioaccumulation, *Estuaries, *Monitoring, Radioactive tracers, Chesapeake Bay, Absorption.

Routine operations of the Calvert Cliffs Nuclear Power Plant (CCNPP) include almost daily releases of low levels of radionuclides to the Chesapeake Bay. A biomonitoring program involving quarterly collection of oysters (Crassostrea virginica) maintained in the effluent of the CCNPP was initiated in 1978 to monitor the radionuclide concentrations in oysters. The application of an oyster bioaccumulation model to the radionuclide biomonitoring data is presented. The model represents radionuclide concentrations in oysters as dependent on the processes of uptake, biological excretion, physical (radioactive) decay, and oyster growth. Driving variables in this model are daily water temperature and the magnitudes of daily plant releases of radionuclides. Monte Carlo simulation involving the variation of model parameters, driving variables and initial conditions was performed to: assess the consequences of alternative plant release scenarios on radionuclide concentrations in oysters, to evaluate alternative scenarios on radionuclide concentrations in oysters and to evaluate alternative sampling frequencies. Results showed that releases restricted to the winter resulted in the lowest radionuclide concentrations in oysters annually, while releases restricted to the spring resulted in the lowest concentrations during the period of the year of commercial and recreational oyster harvest. Results also showed that the estimates of the probabilities of exceeding given radionuclide concentrations with a 90-day sampling interval are similar to estimates based on more frequent sampling. However, an increase in the sampling frequency to three per quarter resulted in substantial reduction in the probability estimation uncertainty. The general modeling approach is appropriate for other biomonitoring situations with known point source discharges. (Author's abstract)
W89-12371

MARINE AMOEBAE FROM WATERS OF NORTHWEST SPAIN, WITH COMMENTS ON POTENTIALLY PATHOGENIC EURYHALINE SPECIES.
Santiago Univ. (Spain). Dept. de Microbiologia y Parasitologia.
C. Arias Fernandez, E. Paniagua Crespo, M. M. Mallen, P. Monica Penas Ares, and L. Castro Casas.
Journal of Protozoology JPROAR, Vol. 36, No. 3, p 239-241, 1989. 3 tab, 21 ref.

Descriptors: *Protozoa, *Pathogens, *Public health, *Estuaries, *Path of pollutants, *Microorganisms, Human diseases, Water pollution effects.

Some species of the salt-water Acanthamoeba are widely distributed in oceans and have been isolated from sediments, surface and bottom waters. Certain species of Acanthamoeba are found in both salt and freshwater. Acanthamoeba polyphaga is known to be a potential pathogen. Possible contamination of waters by these protozoa represent a risk to human health. The protozoa, collected from beaches and estuaries in northwest Spain, were instilled intranasally into albino mice. The mice were observed daily for 30 days. After the animals were sacrificed, the liver, lung and brain were removed for study and histologic sections of the organs were prepared. While no deaths occurred when laboratory animals were inoculated with A. polyphaga to test for pathogenicity, the protozoa were present in all three organs of some, but not all, of the animals. It is concluded that the species of Acanthamoeba pathogenic for man can gain access to the body via seawater. (Friedmann-PTT)
W89-12373

TRANSPORT OF MICROSPHERES AND INDIGENOUS BACTERIA THROUGH A SANDY AQUIFER: RESULTS OF NATURAL-AND FORCED-GRADIENT TRACER EXPERIMENTS.
Geological Survey, Menlo Park, CA. Water Resources Div.
R. W. Harvey, L. H. George, R. L. Smith, and D. R. LeBlanc.
Environmental Science and Technology ESTHAG, Vol. 23, No. 1, p 51-56, January 1989. 5 fig, 3 tab, 20 ref.

Descriptors: *Tracers, *Sand aquifers, *Bacteria, *Path of pollutants, *Groundwater pollution, Aquifers, Dyes, Chlorides, Bromides, Flow, Temperature, Dissolved oxygen, Conductivity.

Transport of indigenous bacteria through sandy aquifer sediments in Cape Cod, MA was investigated in forced-gradient and natural-gradient tracer tests. A diverse population of bacteria was collected and concentrated from groundwater at the site, stained with a DNA-specific fluorochrome 4,6-diamidino-2-phenylindale (DAPI), and injected back into the aquifer. Included with the injectate were a conservative tracer (Br(-) or Cl(-)) and bacteria-sized (0.2-1.3-micron) microspheres having carboxylated, carbonyl, or neutral surfaces. Transport of stained bacteria and all types and size classes of microspheres was evident. In the natural-gradient test, both surface characteristics and size of microspheres affected attenuation. Surface characteristics had the greatest effect upon retardation. Peak breakthrough of DAPI-stained bacteria (forced-gradient experiment) occurred well in advance of bromide at the more distal sampler. Transport behavior of bacteria was substantially different from that of carboxylated microspheres of comparable size. (Author's abstract)
W89-12380

DISTRIBUTION OF ATMOSPHERIC POLYCHLORINATED BIPHENYL CONGENERS BETWEEN VAPOR PHASE, AEROSOLS, AND RAIN.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
J. C. Duinker, and F. Bouchertall.
Environmental Science and Technology ESTHAG, Vol. 23, No. 1, p 57-62, January 1989. 5 fig, 3 tab, 23 ref.

Descriptors: *Path of pollutants, *Polychlorinated biphenyls, *Atmospheric water, *Aerosols, *Rain, Gas chromatography, Chemical analysis, Urban areas, Volatility.

Atmospheric transport is an important pathway for the transfer of polychlorinated biphenyls (PCBs) from land to natural waters. For instance, 60-90% of the PCB burden in the Great Lakes system has been estimated to originate from the atmosphere, and deposition from the atmosphere may be the main source of PCBs in remote oceanic regions. Studies were undertaken using glass beads with strongly improved efficiency for adsorption of relatively volatile PCB fractions. The use of high-resolution multidimensional gas chromatography allows the identification of those congeners that can and those that cannot be determined accurately by gas chromatography/electron capture detection with the use of a single capillary column. Fourteen chromatographically well-separated PCB congeners were analyzed in filtered air, in particulates, and in rain collected simultaneously in the city of Kiel (western Baltic). The PCB mixture was dominated by congeners with a low degree of chlorination in the filtered air and by congeners with a high degree of chlorination in the aerosols and in rain. The vapor phase represented up to 99% of total atmospheric concentrations for the most volatile congeners. Particle scavenging was the dominant source of PCBs in rain, despite the small contribution (only 1 or 2%) of particulate

PCBs to the total atmospheric concentration. (Doria-PTT)
W89-12381

DISTRIBUTION OF POLYCHLORINATED BIPHENYL CONGENERS AND OTHER HALOCARBONS IN WHOLE FISH AND MUSCLE AMONG LAKE ONTARIO SALMONIDS.
Canada Centre for Inland Waters, Burlington (Ontario).
A. J. Niimi, and B. G. Oliver.
Environmental Science and Technology ESTHAG, Vol. 23, No. 1, p 83-88, January 1989. 4 tab, 29 ref.

Descriptors: *Polychlorinated biphenyls, *Chlorinated hydrocarbons, *Bioaccumulation, *Salmon, *Muscle, *Monitoring, Fate of pollutants, Tissue analysis, Lake Ontario, Toxicity, Water pollution effects.

A total of 92 monochlorobiphenyl to decachlorophenyl congeners were monitored in brown and lake trout, small and large rainbow trout, and small and large coho salmon from Lake Ontario. Highest concentrations were among the pentachlorobiphenyl and hexachlorobiphenyl homologues, with 2,2',4,4',5,5'-hexachlorobiphenyl (IUPAC no. 153) the most common. Total congener concentrations ranged from 1 to 10 mg/kg in whole fish and from 0.3 to 4 mg/kg in muscle. Consistent values of congener composition were shown when individual congener levels were expressed as percent of total composition. The 10 most common congeners represented about 52% of the total content; this value does not appear to be influenced by species or by total concentration. The homologues observed averaged about 56% chlorine by weight in fish and muscle. It is concluded that studies of the sublethal effects of PCBs on fishes in contaminated ecosystems could be more definitive if specific congeners rather than total PCBs were monitored. Emphasis should focus on the relation of the concentration of a congener and its toxicity. (Author's abstract)
W89-12383

CHARACTERIZATION OF ORGANIC MATERIAL LEACHED FROM COAL BY SIMULATED RAINFALL.
Maryland Univ., Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 5A.
W89-12386

ACCUMULATION AND PERSISTENCE OF TRIBUTYLTIN IN EELGRASS (ZOSTERA MARINA L.) TISSUE.
New Hampshire Univ., Durham. Dept. of Chemistry.
R. Francois, F. T. Short, and J. H. Weber.
Environmental Science and Technology ESTHAG, Vol. 23, No. 2, p 191-196, February 1989. 5 fig, 3 tab, 27 ref.

Descriptors: *Pesticides, *Fate of pollutants, *Bioaccumulation, *Tin, *Metal organic pesticides, *Sea grasses, *Bioindicators, Decomposition, Biological magnification, Estuaries, Aquatic plants, Food chains, Organotin compounds.

Analysis of eelgrass specimens retrieved from a mesocosm suggested that eelgrass could accumulate butyltin species from seawater and could possibly be used as a sensitive pollution indicator. The objective of this study is to evaluate the impact of this uptake on the residence time of tributyltin in the environment and on its accumulation in estuarine food chains. Decomposition of tributyltin in filtered seawater is compatible with a consecutive debutylation pathway and can be described by consecutive first-order kinetics. Tributyltin is also rapidly taken up from seawater and concentrated by eelgrass (Zostera marine L.), suggesting that estuarine plants could provide a sensitive means to monitor tributyltin pollution in coastal areas. In the plant tissue, the decomposition rate of tributyltin is slower than in filtered seawater, while that of dibutyltin is faster. Monobutyltin then gradually moves from the plant material into the surrounding water. Eelgrass could therefore play a role in detoxifying tributyltin. However, since eelgrass is at the base of estuarine food chains, it could also be an important step in the transfer of tributyltin to higher trophic levels. (Author's abstract)
W89-12387

DISTRIBUTION, REDISTRIBUTION, AND GEOCHRONOLOGY OF POLYCHLORINATED BIPHENYL CONGENERS AND OTHER CHLORINATED HYDROCARBONS IN LAKE ONTARIO SEDIMENTS.
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
B. G. Oliver, M. N. Charlton, and R. W. Durham.
Environmental Science and Technology ESTHAG, Vol. 23, No. 2, p 200-208, February 1989. 11 fig, 4 tab, 50 ref.

Descriptors: *Path of pollutants, *Polychlorinated biphenyls, *Chlorinated hydrocarbons, *Lake Ontario, *Sediments, Benzenes, DDT, Lindane, Pesticides.

The concentrations of PCB congeners and several other chlorinated hydrocarbons such as chlorobenzenes, chlorotoluenes, lindane, mirex, DDT, etc. have been determined in Lake Ontario sediments. Surficial sediments show a reasonably uniform contaminant distribution throughout the sedimentation basins (SBs) with no strong plumes to sources. Sediment samples outside the SBs displayed very low contaminant concentrations, indicating that over the long term sediment-associated contaminants wind up in the SBs. Sediment trap studies showed that a considerable amount of sediment resuspension occurs in the lake, especially when it is unstratified during the winter. This observation helps to explain the fairly uniform concentrations found in the SBs. Sediment core studies showed peak discharges of the contaminants occurred in the late 1950s (DDT) and the mid 1960s (PCBs, mirex, and chlorobenzene) in good agreement with production and usage history. Changes in PCB and DDT composition in the cores are discussed. (Author's abstract)
W89-12389

EVAPORATION POND SEEPAGE.
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. E. Grismer, and B. L. McCullough-Sanden.
California Agriculture CAGRA3, Vol. 42, No. 1, p 4-5, January-February 1988. 1 fig.

Descriptors: *Water pollution sources, *Path of pollutants, *Evaporation, *Ponds, *Seepage, *Drainage water, Drainage, Water pollution control, Permeability, Salinity, Seasonal variation, Kings County, CA, Bacteria, Soil types, Precipitation, Chemical reactions, Groundwater, Drains.

Drainage water evaporation ponds are designed to receive and hold subsurface drainage water until it evaporates. As the water evaporates, chemical constituents are progressively concentrated, including some that are potentially hazardous, such as arsenic and selenium. A study was conducted to assess the effects of salinity and time of ponding on estimates of seepage from evaporation ponds, using both laboratory and field measurements from Kings County, CA. It was concluded that rates of seepage from operational evaporation ponds decline substantially after construction. This decline is irreversible during continuous ponding and may be a result of microbial activity and deposition of suspended matter in pond water. Seepage rates also decrease as the salinity of the pond water increases as a result of chemical precipitation and reaction with pond bed materials, although this process may be partially reversible. Additional measurements of groundwater elevation and quality adjacent to and below the pond indicate that, when operational, interceptor drains surrounding the pond partially contain seepage and confine it to the area below the pond. (Doria-PTT)
W89-12419

BIOLOGICAL CONSEQUENCES OF SELENIUM IN AQUATIC ECOSYSTEMS.
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 5C.
W89-12421

LEACHING OF HEAVY METALS FROM COMPOSTED SEWAGE SLUDGE AS A FUNCTION OF PH.
Indiana Univ. of Pennsylvania. Dept. of Chemistry.
For primary bibliographic entry see Field 5E.
W89-12428

DISTRIBUTION OF CR, PB, CD, ZN, FE AND MN IN LAKE VICTORIA SEDIMENTS, EAST AFRICA.
Nairobi Univ. (Kenya). Dept. of Chemistry.
J. M. Onyari, and S. O. Wandiga.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 6, p 807-813, June 1989. 1 fig, 4 tab, 15 ref.

Descriptors: *Lake sediments, *Africa, *Fate of pollutants, *Lake Victoria, *Chromium, *Lead, *Cadmium, *Zinc, *Iron, *Manganese, Sampling, Atomic absorption spectrophotometry, Geochemistry, Water pollution sources, Wastewater, Oil spills, Bilge, Distribution patterns, Heavy metals, Sediments, Chemical composition.

A study was initiated to investigate the distribution patterns of lead and other metals in Lake Victoria, East Africa, using grab samples analyzed by atomic absorption spectrophotometry. There were statistically significant differences among the mean contents from different locations. Elevated concentrations of some trace elements at some localities indicates a localized pollution problem. Of the metals studied, cadmium content was the lowest, but significant variations were observed between the different sites. Deeper regions of the Winam Gulf were characterized by low metal content, while some shallow regions contained elevated levels of lead, cadmium, zinc, and copper. Maximum values of lead (228 mg/kg), copper (62.8 mg/kg), and zinc (370 mg/kg) were previously obtained at the Shell Oil jetty at Kisumu port. All five stations located inside the port region contained significantly elevated levels of heavy metals compared to other localities. Although discharge of treated wastewater through Kasat River is partly responsible, port activities are of greater significance, especially discharge of ship bilge waters and oil spillages. (Doria-PTT)
W89-12441

MERCURY AND CADMIUM CONTENT IN GREEN MUSSEL, MYTILUS VIRIDIS L. FROM ONRUST WATERS, JAKARTA BAY.
Indonesian Inst. of Sciences, Djakarta. Lab. of Environmental Study.
H. P. Hutagalung.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 6, p 814-820, June 1989. 1 fig, 3 tab, 18 ref.

Descriptors: *Path of pollutants, *Mercury, *Cadmium, *Jakarta Bay, *Bioaccumulation, *Mytilus, Heavy metals, Tissue analysis, Fate of pollutants, Atomic absorption spectroscopy, Mollusks, Regression analysis, Oysters, Population exposure.

Total mercury and cadmium contents were observed in the soft tissues of Mytilus viridis collected from Onrust Island waters, Jakarta Bay, Indonesia. The concentration of mercury and cadmium in whole soft tissue of M. viridis decreased significantly with increasing shell length, meaning that the highest concentrations are present in the smallest mussels. Similar results were obtained for other species of Mytilidae and in oysters. This is probably a reflection of the more rapid metabolism accompanying growth. Thirty-five specimens of large (shell length 6 cm) mussels have mercury and cadmium concentrations ranging from 11-848 ppb (mean = 320 ppb) and 627-2436 ppb (mean = 990 ppb), respectively. Most people living in Jakarta consume M. viridis with shell length more than 6 cm. Based on this criterion, only 11.4% of large

(> 6 cm) mussels exceeded the level recommended by WHO for mercury; therefore, the potential hazard of M. viridis as food for human consumption is small. (Doria-PTT)
W89-12442

ORGANOCHLORINE INSECTICIDE RESIDUES IN FISH AND BIRDS FROM THREE RIVER SYSTEMS ON THE NORTH COAST REGION OF NEW SOUTH WALES.
North Coast Agricultural Inst., Wollongong (Australia).
K. W. McDougall, N. Ahmad, C. R. Harris, and F. R. Higginson.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 6, p 884-890, June 1989. 3 tab, 14 ref.

Descriptors: *Insecticides, *Water pollution effects, *Pesticides, *Halogenated pesticides, *Fish, *Birds, *Coastal streams, *Bioaccumulation, Tissue analysis, River systems, Fate of pollutants, Mullet, Ducks, DDT, DDE, Dieldrin, New South Wales, Mullet, Ducks, Australia, Animal pathology, Magpies, Cormorants.

The extent to which fish and birds collected from river systems in the New South Wales North Coast Region are contaminated with organochlorine (OC) residues was assessed. Three of the major rivers--Clarence, Richmond, and Tweed--on the North Coast Region were selected for study. Fish were taken by Fisheries Division personnel between October 1983 and February 1984. In mid-1984, a more comprehensive study was initiated on the Clarence R., with mullet (Mugil cephalus) being sampled 9 times over 1 y. In mid-1985, a similar study was started on the Tweed R., with mullet being collected monthly for 14 mo. Black ducks (Anas superciliosa), magpies (Gymnorhina tibicen), and black cormorants (Phalacrocorax sulcirostris) were collected from both the Clarence and Tweed R. watersheds by National Parks and Wildlife personnel from 1983-85. No BHC, heptachlor, chlordane, or aldrin residues were detected in any of the fish or birds analyzed. Dieldrin and t-DDT residues in Clarence R. mullet were higher than those detected initially. Average residue levels varied considerably between sampling dates; in general, fat content and residues in the fish tended to be higher during the warmer part of the year. Although Tweed R. mullet contained higher OC insecticide residues than those from the Clarence R., none of the Tweed R. fish was ulcerated. In birds, dieldrin and DDT residues were present at levels substantially higher than those found in fish. At current levels of contamination and with use of OC insecticides for agricultural purposes no longer allowed in Australia, it is concluded that environmental impact from past use of these insecticides will be minimal. (Doria-PTT)
W89-12449

COLLOIDS IN WATER FROM A SUBSURFACE FRACTURE IN GRANITE ROCK, GRIMSEL TEST SITE, SWITZERLAND.
Paul Scherrer Inst., Wuerenlingen (Switzerland).
C. Degueldre, B. Baeyens, W. Goerlich, J. Riga, and J. Verbist.
Geochimica et Cosmochimica Acta GCACAK, Vol. 53, No. 3, p 603-610, March 1989. 7 fig, 3 tab, 23 ref.

Descriptors: *Groundwater management, *Radioactive waste disposal, *Colloids, *Water analysis, *Groundwater pollution, Granites, Groundwater movement, Chemical analysis, Saturation index, Quartz, Fluorine, Electron microscopy, X-ray spectroscopy, Mass spectrometry, Particle size, Switzerland.

The migration of radionuclides through fissures in rock is considered one of the most serious potential hazards of nuclear waste disposal. Colloids from the Grimsel Test Site (Swiss Alps) granitic groundwater were characterized after concentrating the natural colloids by ultrafiltration in situ and in the laboratory. A two-year-long study has shown little variation in the chemistry of the Grimsel water and a calculation of saturation indices indicates that quartz and fluorite are slightly oversaturated in the in situ conditions. Scanning electron microscope investigations indicate a colloid concentration of approximately 10,000,000,000 particles (40 to 1000 nanometers) per liter. On the basis electron spectroscopy for chemical analysis, transmission electron microscopy, energy dispersive x-ray spectrometry, electron energy loss spectrometry, and laser microprobe mass analysis, the particles are a mixture of organic (C, N, O, and S) and inorganic (Si, Ca, S, and to a lesser extent Mg, Sr, and Ba) materials. The alpha specific activity in the colloidal phase is less than 0.5 milliBecquerels per liter. The mode of formation is discussed together with the size distribution and the concentration. (Author's abstract)
W89-12474

ANALYSIS BASED ON INTEGRATED CONSERVATION LAW FOR DISCONTINUOUS ROCK: COUPLED ANALYSIS OF STRESS, HEAT TRANSFER AND GROUNDWATER FLOW.
Saitama Univ., Urawa (Japan). Faculty of Technology.
R. Hamajima, H. Koide, and T. Kawai.
Chigaku Zasshi (Journal of Geography) CGZAAL, Vol. 98, No. 1, p 19-33, 1989. 19 fig, 17 ref. English Summary.

Descriptors: *Path of pollutants, *Geothermal studies, *Groundwater movement, *Radioactive waste disposal, *Underground storage, *Heat transfer, *Stress analysis, Geologic fractures, Petroleum products, Numerical analysis, Deformation.

The precise evaluation of heat transfer and groundwater migration in fractured rocks is the key problem for the geological disposal of nuclear waste, energy extraction from hot dry rocks and underground storage of liquid petroleum gas. The stress state affects the heat transfer and groundwater migration due to the opening or closing of fractures in the rock mass. The numerical method for coupled analysis of stress-heat-water-fractures is developed for the estimation of heat transfer and groundwater flow in the earth's crust. The Rigid-Body-Spring Model (RBSM) has been recently developed to simulate effectively the deformation and fracturing of a jointed rock mass. The direct discretization through the conservation law is proposed for the numerical analysis of heat transfer and water flow coupled with the analysis of stress propagation in the jointed rock mass by the RBSM. The RBSM can be considered as a discrete model to fulfill the conservation law in the stress analysis. The numerical simulation of heat and fluid migration coupled with fracture propagation was applied for the performance assessment of underground oil and liquid petroleum gas storage. (Author's abstract)
W89-12475

ANALYSIS OF HYDROGEOLOGIC SENSITIVITY IN WINONA COUNTY, MINNESOTA.
Minnesota Univ., Minneapolis. Dept. of Soil Science.
M. D. Trojan, and J. A. Perry.
Journal of the Minnesota Academy of Science JMNAAC, Vol. 54, No. 3, p 30-36, Spring 1989. 5 fig, 2 tab, 25 ref.

Descriptors: *Hydrologic models, *Path of pollutants, *Aquifer management, *Sensitivity analysis, Aquifer characteristics, Unconsolidated aquifers, Karst, Sand, Permeability, Infiltration, Computer models, Soil texture, Land management, Land use, Organic matter, Mineralogy, Herbicides, Minnesota.

Hydrogeologic sensitivity to contamination throughout Winona County in southeastern Minnesota was assessed using a recently developed rating method. Sensitivity varied across and within three analysis regions. Region I (Prairie-du-Chien Aquifer) showed a wide range of sensitivity, from moderate to extreme, where the aquifer was unconfined and overlain by a thin layer of unconsolidated material and karst bedrock. Region II (Ironton-Galesville Aquifer) was protected from surface infiltration by a siltstone formation and was not sensitive to contamination. Region III (an unconsolidated surficial aquifer) is highly to extremely sensitive due to large water inputs from adjacent areas; sites located on sand terraces in this region show the greatest susceptibility due to high permeability throughout the vertical profile. The accuracy and scope of evaluations made with the Trojan-Perry rating method will improve and expand as data is collected and utilized and computer capabilities are employed. The following data needs would improve the precision of hydrogeologic sensitivity analysis: (1) soil textural classifications and thicknesses to aid in infiltration and depth-to-water analysis; (2) knowledge of land management practices such as tillage and chemical application, which aid in infiltration and contaminant behavior analysis; (3) knowledge of land-use to improve infiltration, permeability, recharge, and contents, and mineralogy, which can be used to assess the behavior of contaminants. Evaluating contamination sensitivity to atrazine, a widely used herbicide frequently found in country aquifers, illustrates the need for improved data. (Author's abstract)
W89-12476

BACTERIOLOGICAL WATER QUALITY OF A MULTI-USE CATCHMENT BASIN ON THE AVALON PENINSULA, NEWFOUNDLAND.
Memorial Univ. of Newfoundland, St. John's. Dept. of Biology.
For primary bibliographic entry see Field 4C.
W89-12477

SEDIMENTARY RECORD OF POLYCYCLIC AROMATIC AND ALIPHATIC HYDROCARBONS IN THE WINDERMERE CATCHMENT.
Freshwater Biological Association, Ambleside (England).
P. A. Cranwell, and V. K. Koul.
Water Research WATRAG, Vol. 23, No. 3, p 275-283, March 1989. 2 fig, 4 tab, 47 ref. Natural Environment Research Council grant aid to the Freshwater Biological Association.

Descriptors: *Polycyclic aromatic hydrocarbons, *Lake sediments, *Fate of pollutants, *Aliphatic hydrocarbons, Pollution load, Gas chromatography, Mass spectrometry, Ureas, Solvents, Oil pollution, Runoff, Industrial development, Radioactive dating, England.

Sediment profiles from two lakes (Windermere and Priest Pot, Cumbria, United Kingdom), in which the depositional chronology had been previously established by measurement of unsupported Pb210, were analyzed to determine present and past hydrocarbon levels. Chromatographic separation of sedimentary lipids gave two fractions containing aliphatic and aromatic hydrocarbons, respectively. Anthropogenic inputs to the sediments were assessed from the abundance of 17-alpha-(H), 21-beta-(H)-norhopane among aliphatic hydrocarbons and from the combined abundance of ten polycyclic aromatic hydrocarbons (PAH). Subsurface maxima in anthropogenic input occurred in the sediment column of both lakes. For identification of constituents by gas chromatography-mass spectrometry, aliphatic compounds indicative of pollution were isolated by urea adduction; polycyclic aromatic hydrocarbons were isolated by solvent partition. Significant oil pollution in Windermere surficial sediments, probably owing to increased motorboat use and road runoff, was recognized from the dominance of alpha-beta-hopanes, including C31-C34 alkyl derivatives in which the C-22S:C-22R epimer abundance ratio was that of thermally mature geological oil-like sources. The flux of anthropogenic PAH to Windermere reached high levels (4000 nanograms per square centimeter per year) early in this century, probably due to local waterborne input; levels have decreased since the 1970s but remain ten times greater than before the industrial revolution. (Author's abstract)
W89-12479

MOVEMENT OF VIRUSES AFTER ARTIFICIAL RECHARGE.
Webster (Arthur) Pty Ltd., Baulkham Hills (Aus-

tralia).
For primary bibliographic entry see Field 5E.
W89-12481

SURVIVAL OF VIRUSES IN GROUNDWATER.
Webster (Arthur) Pty Ltd., Baulkham Hills (Australia).
For primary bibliographic entry see Field 5E.
W89-12482

EQUILIBRIUM APPROACHES TO NATURAL WATER SYSTEMS--7. COMPLEXATION REACTIONS OF COPPER(II), CADMIUM(II) AND MERCURY(II) WITH DISSOLVED ORGANIC MATTER IN A CONCENTRATED BOG-WATER.
Umea Univ. (Sweden). Dept. of Inorganic Chemistry.
L. Lovgren, and S. Sjoberg.
Water Research WATRAG, Vol. 23, No. 3, p 327-332, March 1989. 5 fig, 3 tab, 25 ref.

Descriptors: *Path of pollutants, *Water quality, *Metal complexes, *Trace metals, *Bogs, *Toxicity, *Copper, *Cadmium, *Mercury, Potentiometers, Freezing, Chlorides, Least squares method, Computer programs, Distribution graphs, Chemical speciation, Organic matter, Organic acids, Equilibrium, Measuring instruments, Wetlands, Dissolved solids, Natural water.

Speciation of trace metals is of great ecotoxicological interest since the uptake and toxicity of metals is correlated with the concentration of certain species more than with the total concentrations of metals. The uptake of mercury in fish is positively correlated with the content of organic matter in natural waters. The purpose of this investigation was to study the acid/base and metal-complexation properties of a bog-water rich in organic matter, and to describe these in terms of a simple model. Trace metal complexation by the dissolved organic matter in a concentrated bog-water was studied using a potentiometric method (glass electrode). Bog-waters, sampled five different times, were concentrated with a freezing-out technique and the complexation reactions involving Cu(++), Cd(++), and Hg(++) were investigated in 0.1 Molar ionic media. In the mercury(++) system a ternary HgH(-)L complex was formed as well. Experimental data were evaluated using the least squares computer program LETAGROPVRID. Distribution diagrams describing the speciation in experimental and natural conditions were constructed using the computer program SOLGAS-WATER. It is concluded that complexation with dissolved organic matter has great importance for the speciation of mercury in a water rich in organic substances, even when conditions are acidic. For copper and cadmium, complexation with the organic acids in acidic waters is considerably less pronounced than for mercury. (Author's abstract)
W89-12485

MATHEMATICAL MODEL OF PHOSPHATE RELEASE RATE FROM SEDIMENTS CONSIDERING THE EFFECT OF DISSOLVED OXYGEN IN OVERLYING WATER.
Tokyo Univ. of Fisheries (Japan). Dept. of Food Science and Technology.
For primary bibliographic entry see Field 5G.
W89-12489

URBAN RUNOFF AND COMBINED SEWER OVERFLOW.
Calocerinos and Spina, Liverpool, NY.
R. N. DeGuida, and K. P. Walker.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 845-848, June 1989. 49 ref.

Descriptors: *Water pollution sources, *Storm runoff, *Literature review, *Urban runoff, *Combined sewer overflows, Hydrology, Land use, Environmental effects, Pollution load, Planning.

Current studies on urban runoff and combined sewer overflow are reviewed, including: (1) hydrologic aspects such as model studies, runoff and storm recurrence intervals, runoff predictions, and runoff quantities associated with land use; (2) runoff quality studies evaluating pollutant loadings for suspended solids, coliforms, oil and grease, copper, iron, lead, mercury, zinc, nutrients, and lead; (3) wastewater management to assess the interaction of hydrotechnical engineering skills that need to be blended with an understanding of wastewater treatment, planning, and community aesthetics; (4) the need for controls to minimize adverse environmental impacts; (5) various treatment alternatives; and (6) assessment of water quality impacts associated with runoff entering receiving waters. (White-Reimer-PTT)
W89-12518

HAZARDOUS AND SOLID WASTES.
Dames and Moore, Atlanta, GA.
For primary bibliographic entry see Field 5E.
W89-12532

NONPOINT SOURCES.
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
J. Spooner, L. Wyatt, W. S. Berryhill, A. L. Lanier, and S. L. Brichford.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 911-924, June 1989. 243 ref.

Descriptors: *Path of pollutants, *Literature review, *Nonpoint pollution sources, *Fate of pollutants, Nutrients, Erosion, Wetlands, Runoff, Pesticides, Groundwater, Model studies, Planning, Legal issues, Coral reefs, Monitoring.

A review of recent studies on nonpoint pollution sources covers several symposia and proceedings dealing with nutrient and pesticide management in agriculture, infiltration and rainfall-runoff, water quality, effects of management on hydrologic resources, erosion and soil loss, wetland hydrology, management, and legal issues. Topics reviewed include: (1) NPS policy, economics, and planning; (2) Water quality and water resources with discussions on surface and groundwater pollution by nutrients, pesticide contamination, pollutant source models, pollution effects on coral reefs, forest related NPS pollution, and overwatering and fertilization of turf grass lawns; (3) Best management practices for NPS control such as tillage conservation practices, filtering units for pesticide residues, subsurface drainage, building and management of wetlands, timber harvest effects, and sludge application effects; and (4) NPS monitoring, modeling, and analytical methods. (White-Reimer-PTT)
W89-12533

MIXING AND TRANSPORT.
P. Shanahan, and D. P. Galya.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 924-931, June 1989. 142 ref.

Descriptors: *Literature review, *Fate of pollutants, *Path of pollutants, Rivers, Estuaries, Coastal waters, Model studies, Satellite imagery, Wind, Sedimentation, Plumes, Jets, Outfall, Intakes, Water currents.

A review of recent papers on mixing and transport is presented for: (1) Rivers using models to examine the fate and transport of pesticides, mass transport, sediment transport, fluvial processes, vertical sediment concentration profiles, nonpoint effects, and landuse effects; (2) Estuaries using models to examine tidal behavior, pollutant transport, the response of inland bays to ocean forcing, the fate and transport of volatile organic compounds, and long-term sedimentation; (3) Coastal studies on the Gulf Stream, coherence between currents and winds, satellite imagery, wind and buoyancy-induced circulation, biological implications of mixing dynamics, and a comparison of model results from one finite-difference and two finite-element two-dimensional models with tidal and current data; (4) Jets, plumes and outfall structures; and (5) Stratified fluids and intake structures. (White-Reimer-PTT)
W89-12534

GROUNDWATER.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
C. T. Miller, and A. S. Mayer.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 954-984, June 1989. 501 ref.

Descriptors: *Literature review, *Groundwater, *Groundwater pollution, *Groundwater management, Single-phase systems, Two-phase systems, Three-phase systems, Physical processes, Chemical processes, Biological processes, Radon, Radionuclide transport, Saline groundwater, Monitoring, Remediation.

In a review of recent groundwater research distinctions are made between single-, two-, and three-phase systems. Single-phase systems refer to groundwater systems subjected to saturated flow conditions, whereas the two-phase and three-phase systems include groundwater systems subjected to unsaturated flow conditions, or conditions influenced by immiscible organic fluids such as petroleum products. Within the single-, two-, and three-phase system categories, a subdivision is made between physical, chemical, or biological processes such as hydrodynamic, sorption/desorption, chemical reaction, and biodegradation. Specialized areas such as radon and radionuclide transport, facilitated transport, and saline groundwaters are also treated separately. In addition, papers concerning groundwater quality monitoring, remediation, and management are reviewed; and within these areas, a variety of individual techniques of monitoring, remediation, and management are considered. (White-Reimer-PTT)
W89-12537

FATE OF POLLUTANTS.
Colorado Univ. at Boulder. Center for Advanced Decison Support for Water and Environmental Systems.
S. C. Chapra, and J. M. Boyer.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 992-998, June 1989. 129 ref.

Descriptors: *Literature review, *Fate of pollutants, *Path of pollutants, *Pesticides, *Heavy metals, *Radioisotopes, Environmental effects, Model studies, Bioaccumulation, Biological magnification, Pollutants.

A review of research concerning the fate of pollutants in the environment includes: (1) A state-of-the-art review of water quality models suited for toxic substance waste-load allocation, and general observations; (2) The concentration and distribution of chlorinated and nonchlorinated xenobiotic chemicals such as PCBs, DDT, Chlorobiphenyls, Arochlor, volatile organics, tributyl phosphates, aromatic hydrocarbons, nitrophenols, naphthalenes, octanol, and petroleum; (3) Pesticide toxicity, bioaccumulation, biodegradation, and kinetic complex formation and equilibrium studies; and (4) Heavy metals and radionuclides in several water systems, resuspension from sediments, accumulation and uptake in biota, biodegradation by bacteria, mechanisms of photoreduction and oxidation, and metal interactions. (White-Reimer-PTT)
W89-12539

DETECTION AND OCCURRENCE OF WATERBORNE BACTERIAL AND VIRAL PATHOGENS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W89-12546

ACIDIC DEPOSITION.
Connecticut Univ., Storrs. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W89-12547

PHOSPHORUS IN SOIL, WATER, AND SEDIMENT: AN OVERVIEW.
Norsk Inst. for Vannforskning, Oslo.
H. Holtan, L. Kamp-Nielsen, and A. O. Stuanes.
Hydrobiologia HYDRB8, Vol. 170, p 19-34, December 1988. 5 fig, 2 tab, 60 ref.

Descriptors: *Water pollution sources, *Reviews, *Eutrophication, *Cycling nutrients, *Phosphorus, Path of pollutants, Geochemistry, Geohydrology, Soil chemistry, Solubility, Chemical reactions, Effluents, Hydrogen ion concentration, Adsorption, Solute transport.

The geochemistry, availability, and abundance of different forms of phosphorus in soil, water, and sediments are reviewed and the present knowledge of phosphorus pathways in ecosystems and how they are regulated are discussed. In a drainage basin, anthropogenic phosphorus is brought into the system mainly as fertilizers and detergents. Sewer systems and runoff processes transfer the phosphorus from the terrestrial environment to the aquatic part of the ecosystem where an accumulation occurs in the sediments of the watercourse. Much of the phosphorus in soil is sorbed to soil particles or incorporated into soil organic matter. The release and export of phosphorus from uncultivated soil is a function of the geology and soil composition, and of the air temperature, precipitation, and the hydrologic conditions (pH, etc.). The solubility of phosphates is controlled by either sorption-desorption or precipitation-dissolution reactions depending on the environment in the soil or sediments. In soil and sediments with large amounts of iron and aluminum hydrous oxides, sorption-desorption reactions are largely responsible for determining the level of orthophosphate in the solution at equilibrium. Algal availability of phosphorus associated with soil-derived materials present in aquatic systems deserves more research. In addition, processes responsible for transport of phosphorus from cropland to aquatic systems and chemical and microbial transformations of phosphorus in lakes and streams deserve more attention. (Author's abstract)
W89-12575

BACKGROUND YIELD OF PHOSPHORUS FROM DRAINAGE AREA AND ATMOSPHERE: AN EMPIRICAL APPROACH.
National Swedish Environmental Protection Board, Uppsala (Sweden). Environmental Quality Lab.
T. Ahl.
Hydrobiologia HYDRB8, Vol. 170, p 35-44, December 1988. 2 fig, 5 tab, 42 ref.

Descriptors: *Water pollution sources, *Eutrophication, *Reviews, *Cycling nutrients, *Phosphorus, *Path of pollutants, Air pollution effects, Geochemistry, Geohydrology, Bogs, Soil chemistry, Effluents, Catchment areas.

The role of phosphorus in the eutrophication of lakes and marine coastal areas has created a need of more information on the size of a virgin background supply of phosphorus. The general pollution of the atmosphere has resulted in an increased amount of anthropogenic phosphorus in air masses over remote ocean areas in the Northern Hemisphere. As a consequence this applies also to remote land areas, where the phosphorus deposition of about 5 kg P/sq km/yr may seem to be 2-3 times the virgin phosphorus deposition. The present background drainage basin yield of phosphorus also is elevated due to a general eutrophication of the terrestrial ecosystem. The background supply varies due to several factors, including drainage basin size, geology, and vegetation. Background yields apparently range from 3-10 kg P/sq km/yr. Accumulation of phosphorus in raised bogs indicates a general eutrophication of the soils and as a consequence of a general eutrophication of the whole ecosystem. (Author's abstract)
W89-12576

PARTICULATE AND DISSOLVED PHOSPHORUS FORMS IN FRESHWATER: COMPOSITION AND ANALYSIS.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
O. Broberg, and G. Persson.
Hydrobiologia HYDRB8, Vol. 170, p 61-90, December 1988. 6 fig, 6 tab, 160 ref.

Descriptors: *Phosphorus, *Water chemistry, *Reviews, Particulate matter, Colloids, Dissolved solids, Pollutant identification, Chemical analysis, Chromatography, Monitoring.

Particulate and dissolved phosphorus components recently have been separated and characterized on the basis of their physical and chemical properties and to some extent their origins. Classically operationally defined monitoring variables (dissolved reactive phosphorus, dissolved unreactive phosphorus, and particulate phosphorus) are not congruent with known specific physical or chemical components of phosphorus in natural waters or with their bioavailability. Physical isolation of true particles, colloids, and molecules of various sizes is possible at present, but it is not recommended for routine use. Chemical characterization of particulate phosphorus is performed mainly by sediment extraction procedures (specialized for inorganic species) and, to a lesser degree, by cell extraction procedures (specialized for organic compounds). The extraction procedures are similar and physical preseparation or alternative procedures (e.g., enzymatic assays) are essential. Smaller colloids and dissolved compounds are separated physically be column chromatography and often are chemically characterized by degradation on the addition of specific enzymes. (See also W89-12577) (Author's abstract)
W89-12578

PHOSPHORUS IN SEDIMENTS: SPECIATION AND ANALYSIS.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
K. Pettersson, B. Bostrom, and O.-S. Jacobsen.
Hydrobiologia HYDRB8, Vol. 170, p 91-101, December 1988. 1 fig, 5 tab, 32 ref.

Descriptors: *Separation techniques, *Phosphorus, *Chemical analysis, *Sediments, Errors, Molecular properties, Performance evaluation, Reviews.

Characterization of sediment phosphorus commonly is based on sequential chemical extractions, in which phosphorus is supposed to be removed selectively from different compounds in the sediments. The first extraction schemes were designed to quantify discrete chemical and mineralogical compounds. As extraction schemes have been tested on different sediments, several systematic errors have been detected and the schemes have been modified and simplified accordingly. Other chemical extractions or treatments have attempted to determine phosphorus bound to particles with a certain strength or binding energy, the purpose being to determine the labile, loosely bound, exchangeable, mobile, or algal-available fraction of sediment phosphorus. All extraction procedures yield operationally defined fractions and cannot be used for identification of discrete phosphorus compounds. The many methodological modifications make it necessary to be cautious when comparing results from the literature in this field. (Author's abstract)
W89-12579

PHOSPHORUS IN INTERSTITIAL WATER: METHODS AND DYNAMICS.
Swedish Environmental Research Inst., Stockholm.
M. Enell, and S. Lofgren.
Hydrobiologia HYDRB8, Vol. 170, p 103-132, December 1988. 15 fig, 5 tab, 139 ref.

Descriptors: *Water chemistry, *Limnology, *Nutrients, *Phosphorus, *Path of pollutants, *Interstitial water, *Solute transport, Trophic level, Chemical reactions, Lake sediments, Monitoring, Eutrophication.

Interstitial (pore) water is important for phosphorus dynamics in limnic ecosystems. The most important processes influencing the generation and transport of pore-water phosphorus from, to, and within the sediment are reviewed. Sampling methodology and the small amount of information available on the various P species in the pore water are discussed. Pore-water P concentrations in various trophic systems and the spatial and temporal distributions also are described. Diffuse P flux calculations and comparison with measured P fluxes also are considered, including factors influencing P fluxes, such as adsorption, possible precipitation mechanisms, advection, and bioturbation. Pore-water P investigations (concentrations and gradients) are an underestimated ecological tool for studying and describing trophic status, redox conditions, spatial and temporal distribution of P-sediment release, potential precipitation mechanisms on a long-term basis, groundwater inflow areas, and lake-water seepage. Pore water investigations (P concentrations) are excellent for describing the trophic status of a lake ecosystem. Large differences in pore-water P concentration occur among oligotrophic, mesotrophic, and eutrophic systems. The technique also affords an opportunity for following seasonal changes and, in eutrophic systems, even short-term variations. Pore-water P concentrations and gradients also can be used for diffusion flux calculations for evaluating the quantitative impact of internal P loading. (Rochester-PTT)
W89-12580

BIOAVAILABILITY OF DIFFERENT PHOSPHORUS FORMS IN FRESHWATER SYSTEMS.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
B. Bostrom, G. Persson, and B. Broberg.
Hydrobiologia HYDRB8, Vol. 170, p 133-155, December 1988. 1 fig, 4 tab, 78 ref.

Descriptors: *Limnology, *Reviews, *Phosphorus, *Bioavailability, *Algal growth, *Eutrophication, Cycling nutrients, Radioactive tracers, Particulate matter, Organic matter.

The recent literature on the bioavailability of different forms of P in freshwater systems is reviewed. Bioavailable P is defined as the sum of immediately available P plus the P that can be transformed into an available form by naturally occurring processes. Methods used to estimate the bioavailable P pool, which vary among studies largely depending on the time perspective applied, are evaluated critically. Most studies on particulate P aim to determine the potentially available P pool. Potential bioavailability of particulate P normally is analyzed in bioassays with algal yield determinations and the available P fraction is characterized from interpretations of results of sequential chemical extractions. NaOH-extractable P is in most studies the most algal-available P fraction. For soil samples and tributary water particulate matter. NaOH-P often has been found to be equal to algal-extractable P. In other studies, depletions of NaOH-P have accounted for the algal P uptake, but only a minor proportion of the fraction has been utilized. Organic P in lake water particulate matter and bed sediments of eutrophic lakes also can be algal-available to a significant extent. Studies on the bioavailability of dissolved P often have been concerned with immediate availability, or the minimum amount of available P. Such studies need other types of experimental design and normally assays with radiotracers are used. Immediately-available P frequently is found to be less than P chemically assessed as dissolve reactive P (DRP) at low (< 10 microgram DRP/l) concentrations. However, immediate availability also may approach or exceed DRP concentrations, especially at higher concentrations. Potential bioavailability, assayed as for particulate P, generally may render higher bioavailability than P assayed as immediately available. Large fractions of dissolve P remain unutilized and are primarily found in the high-molecular weight fraction of dissolved P. (Author's abstract)
W89-12581

PHOSPHATASES: ORIGIN, CHARACTERISTICS AND FUNCTION IN LAKES.
Uppsala Univ. (Sweden). Limnologiska Institutionen.

M. Jansson, H. Olsson, and K. Pettersson.
Hydrobiologia HYDRB8, Vol. 170, p 157-175, December 1988. 2 fig, 3 tab, 102 ref.

Descriptors: *Limnology, *Nutrients, *Path of pollutants, *Phosphorus, *Eutrophication, Biodegradation, Enzymes, Lakes, Hydrogen ion concentration, Bacteria, Algae, Zooplankton, Phosphatases, Hydrolysis, Orthophosphates, Cycling nutrients.

Phosphatases catalyze the liberation of orthophosphate from organic phosphorus compounds. The total phosphatase activity in lake water results from a mixture of phosphatases localized on the cell surfaces of algae and bacteria and from dissolved enzymes supplied by autolysis or excretion from algae, bacteria, and zooplankton. External lake water phosphatases usually have pH optima in the alkaline region. Acid phosphatases generally seem to be active in the internal cell metabolism. The synthesis of external alkaline phosphatases is often repressed at high phosphate concentrations and derepressed at low phosphate concentrations. Phosphatase activity has therefore been used as a phosphorus deficiency indicator in algae and in natural plankton populations. The possibilities for this interpretation of phosphatase activity in lake water are limited, however, and this is discussed. The in situ hydrolysis capacity, i.e., the rate by which orthophosphate is released from natural substrates, is unknown. However, this process should be considered important and the rate of substrate supply, rather than phosphatase activity, appears to limit enzymatic phosphate regeneration. (Author's abstract)
W89-12582

PHOSPHATE UPTAKE AND UTILIZATION BY BACTERIA AND ALGAE.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
M. Jansson.
Hydrobiologia HYDRB8, Vol. 170, p 177-189, December 1988. 3 fig, 54 ref.

Descriptors: *Limnology, *Nutrients, *Path of pollutants, *Phosphorus, *Eutrophication, Enzymes, Orthophosphates, Limiting nutrients, Lakes, Bacteria, Algae, Cycling nutrients, Energy, Escherichia coli.

Bacterial uptake of inorganic phosphate (closely investigated in Escherichia coli) is maintained by two different uptake systems. One (Pst) system) is inorganic-P-repressible and is used in situations of P deficiency. The other system (Pit) is constitutive. The Pit system also takes part in the phosphate exchange process where orthophosphate is exchanged continuously between the cell and the surrounding medium. Algal uptake mechanisms are less known. The uptake capacity increases during starvation but no clearly defined transport systems have been described. Uptake capacity seems to be regulated by internal P pools (e.g., polyphosphates). In mixed algal and bacterial populations, bacteria generally seem to be more efficient in utilizing low phosphate concentrations. Bacteria and algae can share limiting amounts of phosphate provided that the bacteria have a markedly higher affinity for phosphate. Part of the explanation to this problem may be that bacteria are energy-limited rather than phosphate-limited and dependent on algal organic exudates for their energy supply. The possible phosphate exchange mechanism so convincingly demonstrated in Escherichia coli is here suggested to play a key role for the flux of P between bacteria and algae. Such a mechanism also can be used to explain the rapid phosphate exchange between the particulate and the dissolve phase that occurs in short-term 32P-uptake experiments in lake waters. (Author's abstract)
W89-12583

INFLUENCE OF AQUATIC MACROPHYTES ON PHOSPHORUS CYCLING IN LAKES.
Lund Univ. (Sweden). Inst. of Limnology.
W. Graneli, and D. Solander.
Hydrobiologia HYDRB8, Vol. 170, p 245-266, December 1988. 6 fig, 3 tab, 142 ref.

Descriptors: *Limnology, *Macrophytes, *Plant growth, *Eutrophication, *Cycling nutrients, *Phosphorus, Limiting nutrients, Lakes, Lake sediments, Path of pollutants, Shading, Primary productivity, Decomposing organic matter.

Emergent macrophytes take up their phosphorus exclusively from the sediment. Submerged species obtain phosphorus both from the surrounding water and from the substrate, but under normal pore-and lake-water phosphorus concentrations, substrate uptake dominates. Release of phosphorus from actively growing macrophytes (both submerged and emergent) is minimal and epiphytes obtain phosphorus mainly from the water. Decaying macrophytes may act as an internal phosphorus source for a lake and add considerable quantities of phosphorus to the water. A large part of the released phosphorus often is retained in the sediments. In perennial macrophytes, the amount of phosphorus released from decaying shoots depends on the degree of phosphorus conservation within the plant. Macrophyte stands may be a permanent phosphorus sink due to the burial of plant litter. Macrophytes affect the chemical environment (oxygen, pH), which in turn influences the phosphorus cycling in lakes. However, the impact of aquatic macrophytes on whole-lake phosphorus cycling is largely unknown. Controlled full-scale harvesting, herbicide or herbivory experiments are almost totally lacking. Emergent macrophytes respond positively to eutrophication, but fertilization experiments have shown that nitrogen rather than phosphorus may be the key element. Submerged macrophytes are affected adversely by a large increase in the external phosphorus input to a lake. This effect may be caused by epiphyte shading, phytoplankton shading, or deposition of unfavorable sediments. (Author's abstract)
W89-12587

INFLUENCE OF ANIMALS ON PHOSPHORUS CYCLING IN LAKE ECOSYSTEMS.
Lund Univ. (Sweden). Inst. of Limnology.
G. Andersson, W. Graneli, and J. Stenson.
Hydrobiologia HYDRB8, Vol. 170, p 267-284, December 1988. 10 fig, 93 ref.

Descriptors: *Phosphorus, *Cycling nutrients, *Limnology, *Ecosystems, Zooplankton, Benthic fauna, Macroinvertebrates, Fish, Stratification, Lake sediments, Limiting nutrients, Chemical reactions, Path of pollutants, Oxidation-reduction potential, Food chains, Eutrophication, Animal behavior, Animals.

Aquatic animals directly influence the cycling of phosphorus in lakes through feeding and excretion. Traditionally, animals (zooplankton, benthic invertebrates, and fish) have been assigned only minor roles in the process of freshwater phosphorus cycling. They are regarded as consumers without much regulating influence. Today there is growing evidence that animals, predators and herbivores, directly or indirectly can control biomass of primary producers and internal cycling of phosphorus. Herbivorous zooplankton contribute significantly to the regeneration rate of phosphorus in the open water of lakes. They may be the most important phosphorus source of pelagic algae during stagnant conditions. Phosphorus flux rates usually are related inversely to mean body size of the grazers. Bioturbation is an important process for the mineralization of sedimented particulate organic material and for the subsequent return of dissolved substances to the water. The increased release of phosphorus from sediment to water in the presence of macroinvertebrates is most likely mainly a physical mixing phenomenon not caused solely by excretion. However, release of phosphorus from lake sediment may not be in direct proportion to bioturbation because phosphorus can be sorbed at the sediment-water interface as a consequence of redox-sensitive or pH-sensitive chemical reactions. Depending on the habit and intensity of foraging by fish, phosphorus either can be translocated from the sediment to the water or from the water to the benthic community. In deeper lakes fecal deposition and diel vertical/horizontal migration are considered to remove phosphorus from the trophogenic layer. Fish are 'key organisms' in several food chains and may indirectly affect phosphorus cycling in different ways. The processes involved are temperature-dependent and thus most intense during the main vegetative period. As the animals release phosphorus in forms available for plant growth they may be important regulators of lake primary production during periods when external input is low. (Rochester-PTT)
W89-12588

EVOLVING WATER QUALITY IN A COMMON CARP AND BLUE TILAPIA HIGH PRODUCTION POND.
New Alchemy Inst., East Falmouth, MA.
For primary bibliographic entry see Field 2H.
W89-12592

ESTUARINE TRANSPORT OF TRACE METALS IN A BUOYANT RIVERINE PLUME.
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
A. J. Paulson, R. A. Feely, H. C. Curl, and D. A. Tennant.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 3, p , March 1989.

Descriptors: *Trace metals, *Solute transport, *Stream discharge, *Estuaries, *Path of pollutants, *Trace elements, *Heavy metals, *Plumes, *Suspended load, Particulate matter, Water column, Bays, Copper, Zinc, Iron, Lead, Manganese, Dissolved solids, Downstream, Washington, Vertical flow.

The distribution of dissolved and particulate trace metals in Elliott Bay, Washington were determined in April, 1985 during the period of maximum discharge of freshwater for the year. The high freshwater discharge generated a thin buoyant plume (< 2 m) which carried a high suspended load. Calculations made from high resolution sampling of salinity and total suspended matter in the plume suggest that their residence times in the upper 2 m of the water column ranged between 15 and 24 h. Total suspended matter, dissolved and particulate Fe, Mn and Pb, and particulate Cu and Zn in the plume were found to be conservative during their transit through Elliott Bay. Dissolved Cu and Zn exhibited a linear relationship with salinity downstream of a significant anthropogenic source. The particulate phase dominated the horizontal transport of Fe and Pb originating from freshwater sources. In contrast, the dissolved phase contributed 66%, 75% and 35% of the respective total horizontal fluxes of Mn, Zn and Cu that originated from riverine and anthropogenic source. The particulate phase dominated the horizontal transport of Fe and Pb originating from freshwater sources. In contrast, the dissolved phase contributed 66%, 75% and 35% of the respective total horizontal fluxes of Mn, Zn and Cu that originated from riverine and anthropogenic sources. The trace metal concentrations of the suspended matter were uniform in Elliott Bay except for Mn concentrations. Mn concentrations of suspended matter increased with salinity due to mixing of lower concentration, riverine particulates with Puget Sound particulates of higher Mn concentrations. The lack of trace metal enrichments of Elliott Bay surface suspended matter during this period of high discharge was the result of the small vertical loss of suspended matter (< 2% of the horizontal transport) and the rapid transit of suspended matter through the Bay. (Author's abstract)
W89-12602

SCREENING OF GROUNDWATER CONTAMINANTS BY TRAVEL-TIME DISTRIBUTIONS.
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural and Biological Engineering.
D. A. Haith, and E. M. Laden.
Journal of Environmental Engineering (ASCE) JOEEDR, Vol. 115, No. 3, p 497-512, June 1989. 9 fig, 3 tab, 26 ref, append. NSF grant ECE-8219159.

Descriptors: *Traveltime, *Path of pollutants, *Groundwater pollution, *Soil contamination, *Aeration zone, Chemical wastes, Hydrologic

properties, Probabilistic process, Geohydrology, Temporal distribution.

Analytical procedures are proposed for estimating probability distributions of travel times for chemical waste loads to groundwater. Travel distance of the chemical is treated as a renewal process and travel time is given by the number of annual chemical displacements or renewals required for passage through the soil unsaturated zone. The methods were evaluated for two organic chemicals for a range of site conditions near Lexington, KY, and Des Moines, IA. It was found that groundwater contamination risk is very dependent on site-specific soil and hydrologic conditions. Probability distributions based on both hydrologic and soil spatial variability differed markedly from those that considered only hydrologic variability. The effect of soil spatial variability is to increase travel-time variability and risk of groundwater contamination. Travel-time probability distributions were combined with biochemical degradation rates to estimate the expected fraction of chemical mass reaching the water table. This fraction serves as a screening criterion to identify and rank combinations of chemicals and sites that are likely to produce groundwater pollution. (Author's abstract)
W89-12614

MODELING SOLUTE TRANSPORT BY CENTRIFUGATION.
CH2M Hill, Inc., Corvallis, OR.
J. A. Celorie, T. S. Vinson, S. L. Woods, and J. D. Istok.
Journal of Environmental Engineering (ASCE) JOEEDR, Vol. 115, No. 3, p 513-526, June 1989. 8 fig, 3 tab, 22 ref.

Descriptors: *Model studies, *Solute transport, *Soil contamination, *Path of pollutants, *Centrifugation, Soil horizons, Sorption, Permeability coefficient, Plumes, Mathematical equations, Mathematical studies, Soil columns.

Measurements of physical and chemical solute transport properties of soil/waste systems are necessary to predict pollutant migration in soils. The sorption distribution coefficient is most often determined in the laboratory by performing column studies or batch equilibrium tests. Both of these methods suffer from disadvantages. For fine-grained soils, which have small permeabilities, column studies require long periods of time to conduct and batch tests usually overestimate the sorption distribution coefficient because of the solids effect. An alternative method is developed that used a constant head permeameter spinning in a centrifuge. As the permeameter spins, larger confining stresses are imposed on the soil sample and pore water velocities are increased relative to ordinary column studies. The utility of the method was demonstrated by conducting miscible displacement experiments for a range of column sizes and inertial accelerations. Sorption distribution coefficients, based on the local equilibrium assumption, were computed from experimental breakthrough curves using an analytical solution to the solute transport equation. (Author's abstract)
W89-12615

TIME SERIES ANALYSIS OF WATER QUALITY DATA IN PEARL RIVER, CHINA.
Hong Kong Univ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W89-12618

MODELING SODIUM AND CHLORIDE IN SURFACE STREAMS DURING BASE FLOWS.
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 7C.
W89-12619

PREDICTING REAERATION RATES IN TEXAS STREAMS.
Texas Water Commission, Austin. Standards and Evaluation Section.
For primary bibliographic entry see Field 2E.
W89-12620

IMPACT OF LAND USE AND NPS LOADS ON LAKE QUALITY.
Wray and Todd Interests Ltd., Houston, TX.
For primary bibliographic entry see Field 4C.
W89-12621

POST-AUDIT STUDY OF DIELDRIN BIOCONCENTRATION MODEL.
Missouri Univ.-Columbia. Dept. of Civil Engineering.
D. J. Mossman, and J. L. Schnoor.
Journal of Environmental Engineering (ASCE) JOEEDR, Vol. 115, No. 3, p 675-679, June 1989. 2 fig, 13 ref.

Descriptors: *Path of pollutants, *Model studies, *Fate of pollutants, *Simulation, *Bioaccumulation, *Population exposure, *Organic pesticides, Predictions, Model testing, Fish populations, Kinetics, Dieldrin, Chlorinated hydrocarbon.

An annually averaged analytical model, used to simulate and predict dieldrin concentration in fish, is tested for predictions made in 1980 using a long-term data set for pesticide contamination of fish in the Coralville Reservoir of the Iowa River Basin. The model tested uses an analytical loading function, first-order kinetics, and constant coefficients. The model was used on an oil-normalized basis to compare the results among different fish taxa. Predictions made from the simple bioconcentration model developed in 1980 for dieldrin accumulation in fish agree with recent data for carp. Anticipated dieldrin body burden levels of dieldrin for carp in the Coralville Reservoir are 30 micrograms/kg wet weight in 1990. The analytical loading function worked well describing the input of dieldrin to the Coralville Reservoir after its use was banned. Dieldrin measurements of carp tissue indicate that body burden is a function of lake dieldrin concentrations and the lipid fraction of the fish. (Friedmann-PTT)
W89-12623

EMPIRICAL EVALUATION OF OIL SLICK SPREADING INDUCED BY WAVES.
Acadia Univ., Wolfville (Nova Scotia). School of Engineering.
R. J. Palczynski.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24, No. 4, p 331-348, May 1989. 7 fig, 11 ref.

Descriptors: *Oil pollution, *Model studies, *Path of pollutants, *Oil spills, *Oil slicks, *Waves, *Fluid mechanics, Wave propagation, Hydraulic properties, Wave velocity, Physical properties, Surface flow, Simulation, Shallow water, Specific gravity.

The spreading of an oil slick on calm water surfaces and in the presence of shallow water waves was simulated under laboratory conditions. A long channel provided with a mechanical waves generator was filled with tap water and the spreading rates of different types of crude oils released instantaneously were measured on the surface of calm water. The experiments were repeated under various dynamic conditions of the water surface modeled with the waves generator. The spreading rate of oil in the direction of wave propagation was usually greater under the wavy conditions compared to calm water conditions. The measured spreading rate increments due to gravity wave action was usually higher than the surface drift velocities predicted by the Stokes theory. It was confirmed that the velocity of an oil slick increases exponentially with the wave steepness. However, physical properties of crude oil such as viscosity, surface tension and specific gravity do not significantly influence the surface drift of spilled oil induced by the shallow waves. (Author's abstract)
W89-12625

NITRATE LEACHING UNDER IRRIGATION IN THE UNITED STATES.
Delaware Univ., Newark. Dept. of Agricultural Engineering.
W. F. Ritter.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24, No. 4, p 349-378, May 1989. 2 tab, 52 ref.

Descriptors: *Irrigation effects, *Literature review, *Nitrates, *Soil contamination, *Path of pollutants, *Leaching, Irrigable land, Percolation, Infiltration, Leachates, Crop yield, Cultivated lands.

The literature concerning research on nitrate leaching in irrigated agricultural lands is reviewed. Nitrate leaching in both the arid and humid regions of the U.S. is reviewed as well as the effect of water management and nitrogen management on the leaching. Past research has revealed that the mass of nitrate leached is directly related to the leachate volume. Both water management and nitrogen management are important in controlling nitrate leaching, as such management practices that control the amount and the timing of water applied reduce the leaching. While it is impossible to reduce nitrate leaching to the zero level in all regions on coarse-textured soils and still maintain adequate crop yields, applying only enough nitrogen to meet realistic yield goals, timely application, and use of slow release fertilizers will reduce the leaching appreciably. (Friedmann-PTT)
W89-12626

TIME TRENDS OF CHEMICAL CONTAMINANT LEVELS IN CANADIAN ATLANTIC COD WITH SEVERAL BIOLOGICAL VARIABLES.
Department of Fisheries and Oceans, Halifax (Nova Scotia). Physical and Chemical Sciences Branch.
R. K. Misra, J. F. Uthe, D. P. Scott, C. L. Chou, and C. J. Musial.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 5, p 227-232, May 1989. 1 tab, 21 ref.

Descriptors: *Tissue analysis, *Canada, *Atlantic Ocean, *Water pollution effects, *Water pollution effects, *Path of pollutants, *Cod, *Statistical methods, Temporal distribution, Mathematical studies, Data collections, Heavy metals, Polychlorinated biphenyls, Regression analysis.

Investigation of time trends in contaminant levels has been one of the highest priority tasks within the International Council for the Exploration of the Sea (ICES). Univariate procedures of analyzing for temporal variations (provided in the ICES guidelines) are of severely restricted scope. Additional problems, which arise due to mutlicollinearity when two or more covariates are used, including unstable estimates of coefficients of partial regression such that a small perturbation of the data can lead to a large change in estimates with high standard errors. A procedure that has a more extended scope than the univariate one and which overcomes the multicollinearity situation is presented. Canadian Atlantic cod (Gadu morhua) data of the eight-yr period, 1977-1985, are analyzed for time trends for this procedure. Whereas the true mathematical form of temporal variations was not identifiable and will require additional time points, linear trends were significant and provided an effective description of these variations for variables including concentration of heavy metals and polychlorinated biphenyls. (Friedmann-PTT)
W89-12647

DIFFERENTIAL DEPURATION OF POLIOVIRUS, ESCHERICHIA COLI, AND A COLIPHAGE BY THE COMMON MUSSEL, MYTILUS EDULIS.
University Coll., Cork (Ireland). Virology Unit.
U. F. Power, and J. K. Collins.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 6, p 1386-1390, June 1989. 3 fig, 1 tab, 19 ref.

Descriptors: *Escherichia coli, *Mussels, *Water treatment, *Enteroviruses, *Bacteriophage, *Mytilus, *Disinfection, *Pathogens, Bacterial analysis,

Pathogenic bacteria, Epidemiology, Viruses, Depuration, Ultraviolet radiation.

Using laboratory-scale and commercial-scale recirculating, UV depuration systems the elimination of sewage effluent-associated poliovirus, Escherichia coli, and a 22-nm icosahedral coliphage by the common mussel, Mytilus edulis, was studied. In the laboratory system the logarithm levels were reduced by 1.86 for the poliovirus, 2.9 for E. coli, and 2.16 for the coliphage within 52 hours of depuration. The relative patterns and rates of elimination of the three organisms suggest that they are eliminated from mussels by different mechanisms during depuration under suitable conditions. Poliovirus was not included in experiments using the commercial-scale depuration system. However, the differences in the relative rates and patterns of elimination were maintained for E. coli and coliphage in this system, with the logarithm of the E. coli levels being reduced by 3.18 and the logarithm of the coliphage levels being reduced by 0.87. The results from both depuration systems suggest that E. coli is an inappropriate indicator of the efficiency of virus elimination during depuration. The coliphage used appears to be a more representative indicator. Depuration under stressful conditions appeared to have a negligible effect on poliovirus and coliphage elimination rates from mussels. However, the rate and pattern of E. coli elimination were dramatically affected by these conditions. Therefore, monitoring E. coli counts might prove useful in ensuring that mussels are functioning well during depuration. (Author's abstract)
W89-12650

SEASONAL BIOTRANSFORMATION OF NAPHTHALENE, PHENANTHRENE, AND BENZO(A)PYRENE IN SURFICIAL ESTUARINE SEDIMENTS.
Massachusetts Univ. at Boston. Dept. of Biology.
M. P. Shiaris.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 6, p 1391-1399, June 1989. 5 fig, 8 tab, 42 ref. U.S. EPA grants R-811818-01-0 and R-810119-01-0.

Descriptors: *Biotransformation, *Marine sediments, *Fate of pollutants, *Hydrocarbons, *Naphthalene, *Phenanthrene, *Benz(a)pyrene, *Estuaries, Sediments, Transformation rates, Salinity, Temperature, Hydrogen ion concentration, Seasonal variation, Mineralization, Massachusetts, Boston Harbor.

Transformation rates of naphthalene, phenanthrene, and benzo(a)pyrene in oxidized surficial sediments of a polluted urban estuary, Boston Harbor, Mass., were determined over a period of 15 months. Three sites characterized by muddy sediments were selected to represent a >300-fold range of ambient polycyclic aromatic hydrocarbon (PAH) concentration. Transformation rates were determined by a trace-level radiolabel PAH assay which accounted for PAH mineralization, the formation of polar metabolites, residue, and recovered parental PAHs in sediment slurries. Transformation rates of the model PAHs increased with increasing ambient PAH concentration. However, turnover times for a given PAH were similar at all sites. The turnover times were as follows: naphthalene, 13.2 to 20.1 days: phenanthrene, 7.9 to 19.8 days; and benzo(a)pyrene, 53.7 to 82.3 days. At specific sites, rates were significantly affected by salinity, occasionally affected by temperature, but not affected by pH over the course of the study. Seasonal patterns of mineralization were site to site. Seasonal potential heterotrophic activities as measured by acetate and glutamate mineralization rates did not always coincide with PAH mineralization maxima and minima, suggesting that the two processes are uncoupled in estuarine sediment. (Author's abstract)
W89-12651

VOLATILIZATION OF SELENIUM BY ALTERNARIA ALTERNATA.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
E. T. Thompson-Eagle, W. T. Frankenberger, and U. Karlson.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 6, p 1406-1413, June 1989. 6 fig, 1 tab, 28 ref. Federal-State SanJoaquin Valley Drainage Program, contract 7-FC-20-05110.

Descriptors: *Biotransformation, *Aquatic fungi, *Fate of pollutants, *Water pollution treatment, *Selenium, *Methylation, Irrigation, Path of pollutants, Hydrogen ion concentration, Temperature, Substrates, Microbial degradation, Toxicity, California, Wildlife habitats, Biological treatment, Volatilization.

Seleniferous water continues to be a serious problem to wildlife in the central valley of California. Water samples collected from Kesterson Reservoir, Peck Ranch, and Lost Hills evaporation pond facilities contained between 0.005 and 5 mg of Se per liter. The objective of this study was to isolate Se-methylating organisms in evaporation pond water and to assess, through enrichment and manipulation of their optimal growth parameters, the environmental factors which govern microbial Se methylation. Alternaria alternata was isolated as an active Se-methylating organism. The volatile product was identified as dimethylselenide. The effects of pH, temperature, Se substrates, and methyl donors on the ability of A. alternata to methylate Se were investigated in liquid medium containing 100 mg of Se per liter. The optimum pH and temperature for methylation were 6.5 and 30 C, respectively. Selenate and selenite were methylated more rapidly than selenium sulfide and various organic Se compounds (6-selenoguanosine, 6-selenoinosine, seleno-DL-methionine, and 6-selenopurine). L-Methionine and methyl cobalamine (0.1 microM) stimulated dimethylselenide production. This study demonstrates that Se-methylating organisms are present in evaporation pond water and are capable of liberating substantial quantities of Se in the volatile dimethylselenide form. By determining the optimum environmental conditions which stimulate volatilization, it may be possible to design a way to remove Se from seleniferous water in situ. (Author's abstract)
W89-12652

ANAEROBIC DEGRADATION OF CHLOROAROMATIC COMPOUNDS IN AQUATIC SEDIMENTS UNDER A VARIETY OF ENRICHMENT CONDITIONS.
Technical Resources, Inc., Gulf Breeze, FL.
B. R. S. Genthner, W. A. Price, and P. H. Pritchard.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 6, p 1466-1471, June 1989. 3 fig, 3 tab, 27 ref. U.S. EPA contracts 68-03-3479 with Technical Resources, Inc., and 68-03-6265 with Technology Applications, Inc.

Descriptors: *Chlorinated hydrocarbons, *Bottom sediments, *Culturing techniques, *Anaerobic digestion, *Aromatic compounds, *Aquatic sediments, *Fate of pollutants, Industrial effluents, Bromoethane sulfonic acid, Nitrates, Sulfates, Potassium nitrate, Sodium sulfate, Chlorophenols, Chlorobenzoates, Enrichment.

Anaerobic degradation of monochlorophenols and monochlorobenzoates in a variety of aquatic sediments was compared under four enrichment conditions. A broader range of compounds was degraded in enrichments inoculated with sediment exposed to industrial effluents. Degradation of chloroaromatic compounds was observed most often in methanogenic enrichments and in enrichments amended with 1 mM bromoethane sulfonic acid. Degradation was observed least often in enrichments with added nitrate or sulfate. The presence of 10 mM bromoethane sulfonic acid prevented or inhibited degradation of most compounds tested. Primary enrichments in which KNO3 was periodically replenished to maintain enrichment characteristics degraded chlorobenzoates, but not chlorophenols. In contrast, primary enrichments in which Na2SO4 was periodically replenished failed to degrade any chloroaromatic compounds. Upon transfer to fresh medium, none of the sulfate enrichments required the presence of Na2SO4 for degradation, while only two nitrate enrichments required the presence of KNO3 for degradation. As a class of compounds, chlorophenols were degraded more readily than chlorobenzoates. However, as individual compounds 3-chlorobenzoate, 2-chlorophenol, and 3-chlorophenol degradation was observed most often and with an equal frequency. Within the chlorophenol class, the relative order of degradability was ortho > meta > para, while that of chlorobenzoates was meta > ortho > para. In laboratory transfers, 2-chlorobenzoate, 3-chlorobenzoate, and 2-chlorophenol degradation was most easily maintained, while degradation of parachlorinated compounds was very difficult to maintain. (Author's abstract)
W89-12653

CHARACTERIZATION OF ANAEROBIC DECHLORINATING CONSORTIA DERIVED FROM AQUATIC SEDIMENTS.
Technical Resources, Inc., Gulf Breeze, FL.
B. R. S. Genthner, W. A. Price, and P. H. Pritchard.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 6, p 1472-1476, June 1989. 2 fig, 2 tab, 19 ref. U.S. EPA contracts 68-03-3479 with Technical Resources, Inc., and 68-03-6265 with Technology Applications, Inc.

Descriptors: *Chlorinated hydrocarbons, *Biotransformation, *Anaerobic digestion, *Microbial degradation, *Fate of pollutants, Aromatic compounds, Chlorophenol, Chlorobenzoate, Dechlorinating consortia, Methanogenic consortia, Anaerobic dechlorination, Potassium nitrate, Sediments, Nitrogen removal, Aerobic digestion.

Four methanogenic consortia which degraded 2-chlorophenol, 3-chlorophenol, 2-chlorobenzoate, and 3-chlorobenzoate, respectively, and one nitrate-reducing consortium which degraded 3-chlorobenzoate were characterized. Degradative activity in these consortia was maintained by laboratory transfer for over 2 years. In the methanogenic consortia, the aromatic ring was dechlorinated before mineralization to methane and carbon dioxide. After dechlorination, the chlorophenol consortia converted phenol to benzoate before mineralization. All methanogenic consortia degraded both phenol and benzoate. The 3-chlorophenol and 3-chlorobenzoate consortia also degraded 2-chlorophenol. No other cross-acclimation to monochlorophenols or monochlorobenzoates was detected in the methanogenic consortia. The consortium which required nitrate for the degradation of 3-chlorobenzoate degraded benzoate and 4-chlorobenzoate anaerobically in the presence of KNO3, but not in its absence. This consortium also degraded benzoate, but not 3-chlorobenzoate, aerobically. (Author's abstract)
W89-12654

HYBRIDIZATION OF DNA PROBES WITH WHOLE-COMMUNITY GENOME FOR DETECTION OF GENES THAT ENCODE MICROBIAL RESPONSES TO POLLUTANTS: MER GENES AND HG(2+) RESISTANCE.
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
T. Barkay, C. Liebert, and M. Gillman.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 6, p 1574-1577, June 1989. 2 fig, 1 tab, 17 ref.

Descriptors: *Nucleic acids, *Genetics, *Water pollution effects, *Bioindicators, *Mercury, *Fate of pollutants, Microbiological studies, Probes, Testing procedures, Genes, Florida, Estuaries, Bayous.

Aquatic microbial communities adapt to the presence of Hg(2+) in their environment by increased Hg(2+) tolerance and accelerated rates of Hg(2+) reduction to Hg(0). The use of DNA probes to determine the abundance of sequences similar to four characterized mer genes in nucleic acid fraction obtained from Hg(2+)-adapted and -unadapted (control) microbial communities is described. Estuarine water samples were collected from Santa Rosa Sound, Fla. and freshwater samples were taken from Thompson's Bayou, Fla. Nucleic acids

were extracted and purified from cell pastes obtained by a filtration process and four probes were used to detect mer homologous DNA in the genomes of Hg(2+) exposed and control communities. A 29-fold enrichment in sequences similar to the mer genes of transposon Tn501 occurred during adaptation in a freshwater community. In an estuarine community, all four mer genes were only slightly enriched (by three to five-fold), suggesting that additional, yet uncharacterized, mer genes encoded adaptation to Hg(2+). This approach can be used for the identification of functional genes, and their relatedness to ecological processes could be used to predict the fate and, indirectly, the effects of pollutants in the environment. (White-Reimer-PTT)
W89-12659

SURVIVAL AND ACTIVITY OF A 3-CHLOROBENZOATE-CATABOLIC GENOTYPE IN A NATURAL SYSTEM.
Carleton Univ., Ottawa (Ontario). Dept. of Biology.
R. R. Fulthorpe, and R. C. Wyndham.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 6, p 1584-1590, June 1989. 5 fig, 1 tab, 25 ref.

Descriptors: *Microbial degradation, *Genetic studies, *Fate of pollutants, *Chlorobenzoate, *Most probable number test, Streptomycin, Genes, Catabolic genotypes, Microbiological studies, DNA probes.

A chlorobenzoate-degrading Alcaligenes strain, BR60, was introduced to flow-through lake microcosms and exposed to 3-chlorobenzoate (3Cba) concentrations from 0 to 25 microM. A DNA probe specific for BR60 chlorobenzoate catabolic genes was used with the most probable number (MPN) technique to enumerate bacteria harboring this genetic information. This MPN-DNA hybridization method combined with (U-14C)3Cba uptake rate measurements allowed the correlation of the size and activity of a specific catabolic population in a natural mixed community for the first time. An experiment involving the release of streptomycin-resistant strain of BR60 indicated that estimates of bacteria carrying the introduced catabolic genotype often outnumbered plate count estimates of viable BR60 by as much as 3 orders of magnitude, particularly when 3Cba inputs were high. The MPN-DNA hybridization method provided catabolic population estimates highly correlated to 3Cba exposure levels and the (U-14C)3Cba uptake rates in the microcosms. Plate counts of BR60 were poorly correlated with both 3Cba exposure levels and uptake rates. In the absence of chlorobenzoate selection, the catabolic genotype declined to very low levels by the MPN-DNA hybridization technique after 8 weeks in the microcosms. (Author's abstract)
W89-12660

ECOLOGY OF VIBRIO CHOLERAE NON-O1 AND SALMONELLA SPP. AND ROLE OF ZOOPLANKTON IN THEIR SEASONAL DISTRIBUTION IN FUKUYAMA COASTAL WATERS, JAPAN.
Hiroshima Univ. (Japan). Faculty of Applied Biological Science.
K. Venkateswaran, T. Takai, I. M. Navarro, H. Nakano, and H. Hashimoto.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 6, p 1591-1598, June 1989. 2 fig, 9 tab, 35 ref.

Descriptors: *Salmonella, *Pathogenic bacteria, *Marine bacteria, *Path of pollutants, *Zooplankton, *Japan, *Coastal waters, *Vibrio, Temperature, Salinity, Nutrients, Water pollution, Ecology, Seasonal distribution.

Seasonal variation of human pathogens such as Vibrio cholerae non-O1 and Salmonella spp. in Fukuyama coastal waters and the role of zooplankton in their distribution were studied for a period of 1 year. Comparison of two established methods, viz., the elevated temperature method and the two-step enrichment method of enumerating V. cholerae, showed that the former is superior in the recoveries of V. cholerae non-O1. Isolation of this pathogen on a wider range of salinities (0.4 to 32.5 ppt) revealed that these organisms are apparently an autochthonous component of the aquatic environment. Temperature appears to be the most crucial element in governing the distribution of V. cholerae non-O1. Among the 69 isolates serotyped, 22 different serovars were identified, while one isolate failed to react with any of the known Louisiana State University antisera tested. Zooplankton samples did not harbor more V. cholerae non-O1 than the water column did. Better isolation of an allochthonous pathogen, viz., Salmonella spp., was noticed from the water samples when swabs were employed. Of the 251 isolates serotyped, 18 serotypes with three variants of Salmonella spp. were identified. A high amount of nutrients in the water column increased the survival rate of these pathogens in saline waters as evidenced by a higher incidence of various serotypes in polluted Fukuyama port then in clean marine waters. Salmonella spp. association with zooplankton remained below detectable levels in most of the sampling periods. No significant association between V. cholerae non-O1 or Salmonella spp. with zooplankton could be noticed as influencing their seasonal distribution. (Author's abstract)
W89-12661

EFFECT OF MULTIPLE CONTAMINANT MIGRATION ON DIFFUSION AND ADSORPTION OF SOME DOMESTIC WASTE CONTAMINANTS IN A NATURAL CLAYEY SOIL.
University of Western Ontario, London. Geotechnical Research Centre.
F. S. Barone, E. K. Yanful, R. M. Quigley, and R. K. Rowe.
Canadian Geotechnical Journal CGJOAH, Vol. 26, No. 2, p 189-198, May 1989. 11 fig, 4 tab, 10 ref.

Descriptors: *Path of pollutants, *Soil contamination, *Domestic wastes, Pollutant migration, Diffusion, Adsorption, Clays, Chlorides, Sodium, Potassium, Magnesium, Calcium, Ammonia, Model studies.

During a testing period of 15 days, samples from the overlying leachate were regularly collected and analyzed for Cl(-), Na(+), K(+), Mg(++), and Ca(++). At the end of the test, the soil layer was sectioned to determine the pore-water and adsorbed concentration variations with depth for each species. The mathematical model POLLUTE was then used to back-figure both the diffusion coefficient (D) and the adsorption term (pK). Ca(++) and Mg(++), originally predominant on the clay exchange sites, were heavily desorbed to accommodate the adsorption of migrating Na(+), K(+) and possibly NH4(+), causing hardness halo effects that the model could not fit. The importance of multiple contaminant migration on diffusion rates was assessed by comparing the leachate models with similar models using a variety of single salts dissolved in distilled water as the source solutions. For the single-salt models, all species considered, including Ca(++) and Mg(++), behaved in a way that could be described by conventional Fickian theory. A comparison of the diffusion and adsorption parameters obtained from the two types of models indicated that for both Na(+) and K(+), the measured D and pK from the leachate models were 20 and 60% lower, respectively, than the values obtained from the single-salt models. For Cl(-), the diffusion coefficient obtained from the leachate models was 25% higher than that obtained from the single-salt models. For the Sarnia grey soil used, both D and pK are significantly influenced by the types and amounts of co-diffusing species present in the initial source solutions. (Author's abstract)
W89-12671

RELATIONSHIPS BETWEEN LEVELS OF RADIOCAESIUM IN COMPONENTS OF TERRESTRIAL AND AQUATIC FOOD WEBS OF A CONTAMINATED STREAMBED AND FLOODPLAIN COMMUNITY.
Savannah River Ecology Lab., Aiken, SC.
I. L. Brisbin, D. D. Breshears, K. L. Brown, M. Ladd, and M. H. Smith.
Journal of Applied Ecology JAPEAI, Vol. 26, No. 1, p. 173-182, 1989. 1 fig, 3 tab, 18 ref. U.S. Dept. of Energy contract DE-AC09-76SR00819 and the Institute of Ecology of the U. of Georgia and the Los Almos Nat. Lab. contract W-7405-ENG.

Descriptors: *Cesium radioisotopes, *Path of pollutants, *Streambeds, *Flood plains, *Bioindicators, *Radioactive wastes, *Food chains, *Bioaccumulation, *South Carolina, Nuclear powerplants, Sediments, Benthos, Aquatic plants, Aquatic animals, Terrestrial plants, Terrestrial animals.

The results of a 1981 streambed community study were compared with the results of a 1971 study of the same area in an attempt to document any changes which may have occurred in the distribution of radiocaesium in the various ecosystem components. Twelve study locations were established along Steel Creek, in Barnwell County, South Carolina, between the swamp/delta and the uppermost nuclear reactor from which contaminated effluents had been released. The following results were determined: (1) Radiocaesium concentrations of plants and animals declined 50-98% from 1971 to 1981; (2) Radiocaesium concentrations of animals did not differ significantly between samples from locations along the stream channel, reflecting a previously demonstrated uniform distribution of radiocaesium in the sediments, and did not differ between animals from terrestrial vs. aquatic food webs; (3) Significant correlations between radiocaesium contents of food-web components were about twice as frequent as would be expected by chance, but only seven of the twenty-three significantly correlated pairs contained components that were likely to have a direct trophic association; (4) Caution should be used in arguing causation on the basis of simple correlations of contaminant levels of biotic compartments alone; (5) The best 'indicator species' for radiocaesium contamination in aquatic food webs were the plants Typha and Polygonum and, even better, the animals Palaemonetes and Etheostoma. In terrestrial food webs, the best indicators were the plants Alnus and Salix and the animal groups of Araneae, Odonata (damsel flies) and orthoptera. (White-Reimer-PTT)
W89-12688

SURFACE ABSORPTION OF ALUMINIUM BY GILL TISSUE AND BODY MUCUS OF RAINBOW TROUT, SALMO GAIRDNERI, AT THE ONSET OF EPISODIC EXPOSURE.
Dundee Univ. (Scotland). Dept. of Biological Sciences.
R. D. Handy, and F. B. Eddy.
Journal of Fish Biology JFIBA9, Vol. 34, No. 6, p 865-874, June 1989. 3 fig, 36 ref.

Descriptors: *Animal tissues, *Path of pollutants, *Acid rain effects, *Trout, *Aluminum, *Gills, Mucus, Absorption, Skin, Hydrogen ion concentration, Blood, Cations, Polyelectrolytes, Toxicity, Fish physiology.

Rainbow trout were exposed to an episode of artificial soft water at pH 5.4 containing 0.95 mg/L of aluminum for 1 hr after which gill, skin, body, mucus and blood aluminum concentrations were determined. Skin and blood showed no significant increase in aluminum content, whereas whole gill tissue and body mucus showed significant increases. The low values for blood and skin aluminum content suggest that the gill exterior and the body mucus are the major sites of aluminum absorption. The body mucus layer on the fish surface probably contains fixed negative charges which are available to bind cations when the mucus layer is at neutral pH. However, body mucus is a complex polyelectrolyte and factors other than charge such as ionic strength may affect ion binding. The skin is relatively impermeable compared with the gills which are adapted for ion and gas exchange so it is likely that aluminum has its major toxic effects on the gill tissue. An increase in body mucus aluminum was observed within 5 min. of exposure and an increase in gill aluminum within 30 min. The gill aluminum increase may be attributed to aluminum binding to freshly secreted gill mucus as well as binding directly to gill tissue. It has been demonstrated that fish are able to respond to toxic conditions in minutes rather than hours, and that body

mucus as well as gills are important sites of aluminum absorption. Secreted gill mucus may have a protective role on the gill apical membrane during aluminum exposure. (White-Reimer-PTT)
W89-12693

FLOW OF THE NATANEBI RIVER POLLUTION INTO THE BLACK SEA (STOK ZAGRIAZNIAIUSHCHIKH VESHCHESTV R NATANEVI V CHERNOE MORE).
Zakavkazckii Regionalnyi Nauchno-Issled. Inst.
L. U. Shavliashvili, L. N. Intskirveli, M. G. Khatiashvili, and Z. I. Meskhishvili.
Soobshcheniia Akademii Nauk Gruzinskoi SSR SAKNAH, Vol 130, No 1. p 105-108, April 1988. 1 tab, 6 ref. English summary.

Descriptors: *Fertilizers, *Water pollution sources, *Agricultural chemicals, *Black Sea, Agricultural runoff, Nitrogen compounds, Path of pollutants.

The properties of nitrogen fertilizers washing from the soils of the Colchis lowland into the Natanebi river and its chemical composition are discussed. The annual distribution of the pollutant run-off and its flow into the Black Sea were determined. Recommendations on water resource controls and judicious utilization of fertilizers are presented. (Author's abstract)
W89-12711

TRANSMISSION OF ENTERIC DISEASE ASSOCIATED WITH WASTEWATER IRRIGATION: A PROSPECTIVE EPIDEMIOLOGICAL STUDY.
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
For primary bibliographic entry see Field 5E.
W89-12729

HYDROLYSIS OF METHYL PARATHION IN A FLOODED SOIL.
Central Rice Research Inst., Cuttack (India). Lab. of Soil Microbiology.
M. Sharmila, K. Ramanand, and N. Sethunathan.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 43, No. 1, p 45-51, July 1989. 3 tab, 10 ref.

Descriptors: *Flooding, *Fate of pollutants, *Soil water, *Parathion, *Insecticides, *Hydrolysis, Degradation, Nitrogen, Sulfates, Temperature effects, Soil Organic matter, Detection limits, Laterites, Rice, Nitrogen removal, Acidic soils, Oxidation-reduction potential, Flood irrigation, Hydrogen ion concentration, Submergence, Inhibition, Soil chemistry, Soil types.

The reason for the hydrolytic pathway of methyl parathion (0,0-dimethyl 0-p-nitrophenyl phosphorothioate) (MP) in flooded Sukinda soil (pH 6.9, organic matter 0.62%, total nitrogen 0.04%) was explored. An acid sulfate (Pokkali) soil (pH 5.4, organic matter 5.51%, total nitrogen 0.21%) and a laterite (Pattambi) soil (pH 6.0, organic matter 1.04%, total nitrogen 0.063%) were also tested. MP disappeared more rapidly at 35 C than at 25 C in all three soils under flooded conditions. The insecticide was degraded more rapidly in Pokkali and Pattambi soils than in Sukinda soil. In Pokkali and Pattambi soils held at 35 C, the insecticide reached undetectable levels in 12 days. In Sukinda soil, hydrolysis was the only pathway of MP degradation at both temperatures. In Pokkali and Pattambi soils, degradation proceeded by both nitro group reduction and hydrolysis at both temperatures; but, nitro group reduction was more pronounced than hydrolysis. Soil was flooded for 30 days prior to the addition of MP to generate more reduced conditions. The redox potential of the soil was -100 mV after 10 days of flooding and -145 mV after 30 days of flooding. Even more reduced conditions of 30-day preflooded soil did not seem to trigger the nitro group reduction of MP in Sukinda soil. As in 10-day preflooded soil, MP was degraded essentially by hydrolysis in 30-day preflooded soil. The pH of 10-day or 30-day preflooded soil ranged between 6.9 and 7.04. Addition of rice straw to flooded Sukinda soil triggered nitro group reduction. Sukinda soil had very low organic matter content 0.62%) when compared to Pokkali (5.51%) and Pattambi (1.04%) soils. Soils poor in organic matter undergo slow reduction upon submergence and therefore, may not be congenial for nitro group reduction. Even 30-day preflooded Sukinda soil at 35 C (-145mV) had higher redox potential than 10-day preflooded Pokkali (-200 mV) and Pattambi (-175 mV) soils. The inhibition of nitro group reduction of MP in flooded Sukinda soil is related to its low organic matter content and higher redox potential. (Miller-PTT)
W89-12736

BIOACCUMULATION AND DEPURATION OF SOME TRACE METALS IN THE MUSSEL, PERNA VIRIDIS (LINNAEUS).
Central Inst. of Fisheries Technology, Cochin (India).
P. T. Lakshmanan, and P. N. Nambisan.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 43, No. 1, p 131-138, July 1989.

Descriptors: *Path of pollutants, *Bioaccumulation, *Trace metals, *Mussels, Seawater, Mercury, Copper, Zinc, Lead, Depuration, Bioindicators, Bioconcentration, Bioavailability, Sublethal effects, Tissue analysis, Population exposure.

The bioaccumulation and depuration of Hg, Cu, Zn and Pb by the mussel Perna viridis (Linnaeus) from seawater is reported and its suitability as an indicator organism for metal pollution is explored. Uptake and release experiments were conducted in static replenishing seawater systems following standard methods. Bioconcentration was measured in the exposed mussels at intervals of 2, 4 and 6 days. Results clearly indicate the ability of the mussel to accumulate appreciable quantities of trace metals from the environmental water. The amounts of metals in the tissue were very much dependent on the exposure concentration and length of time. The decreasing concentration factors (CFs) with increasing metal concentration may be due to the deactivating effect of the metal ions in the animal at higher concentrations. Sequestering of the metals and subsequent release of additional metals could also lead to lower CFs. The low bioavailability of the metals may be another reason. The rapid and continuous accumulation of Pb even at higher concentrations may be attributed to its non-lethality to the animal (nonlethal up to 10 ppm). It is confirmed that the ability of the mussel P. viridis to reflect the environmental concentrations of mercury, copper, zinc and lead in their body tissues. The metals levels also declined in the animal in a pollutant-free medium. This suggests that the mussel may be a potential sentinal organism in environmental monitoring of trace metal pollution. (Miller-PTT)
W89-12740

UPTAKE AND DISTRIBUTION OF 203HG BY FISH FINGERLINGS, CIRRHINA MRIGALA, EXPOSED TO LINEAR ALKYL BENZENE SULPHONATE.
Industrial Toxicology Research Centre, Lucknow (India). Ecotoxicology Section.
V. Misira, V. Kumar, S. D. Pandey, and P. N. Viswanathan.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 43, No. 1, p 139-143, July 1989. 1 tab, 18 ref.

Descriptors: *Isotopic tracers, *Bioaccumulation, *Path of pollutants, *Linear alkyl sulfonates, *Mercury, *Fish, *Detergents, Gills, Uptake, Accumulation, Immature growth stage, Synergistic effects, Muscle, Liver, Toxicity.

The uptake and distribution of mercury was studied in the presence and absence of detergent to test for any combined effects. The uptake and distribution of radioactive mercury by fish fingerlings shows that the presence of detergent enhanced the uptake of 203Hg in the order gill > liver > brain > muscles. The increase in 203Hg content n the gill was found to be (120-140%) $p < 0.001$, in liver (51-88%) $p < 0.001$, in brain (33-42%) $p < 0.001$ and decrease in muscle (31-15%) $p < 0.01$ to $p < 0.02$ on exposure from 12 to 48 hr. The amount of mercury taken up by the individual fish in the experimental group was 70% higher in 12 hr ($p < 0.001$), 74% in 24 hr ($p < 0.001$), 78% in 36 hr ($p < 0.001$) and 86% in 48 hr ($p < 0.001$). The increase in the content of 203Hg from 12 to 48 hr in gill, brain and liver suggested its accumulation with the time of exposure whereas decrease in 203Hg in case of muscles from 12 to 48 hr suggested its slow elimination. The enhanced uptake of 203Hg in the presence of detergent by different tissues in fish depends upon the concentration of mercury in water, time of exposure, rate of elimination, valence state of mercury and solubility. An additive toxicity was noticed in rainbow trout for mixtures of anionic detergents ABS and LAS and copper and mercury. (Miller-PTT)
W89-12741

DISTRIBUTION OF ATRAZINE, SIMAZINE, ALACHLOR, AND METOLACHLOR IN SOIL PROFILES IN CONNECTICUT.
Connecticut Agricultural Experiment Station, New Haven.
L. Q. Huang, and C. R. Fink.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 43, No. 1, p 159-164, July 1989. 2 tab, 10 ref.

Descriptors: *Soil profiles, *Path of pollutants, *Triazine pesticides, *Herbicides, *Phenylamide herbicides, *Groundwater pollution, *Soil water, *Connecticut, Pesticides, Atrazine, Simazine, Alachlor, Metolachlor, Fate of pollutants, Soil organic matter, Test wells, Interagency cooperation.

The results of a study of pesticide pollution of the ground waters of the state of Connecticut, conducted by the Connecticut Department of Environmental Protection, in cooperation with the U.S. Geological Survey (USGS) and the Connecticut Agricultural Experiment Station, are reported. Results of analyses are reported of soil samples collected by USGS during 1987 using new and more sensitive analytical methods revealed the presence of these herbicides throughout the soil profile at a number of sites. Water samples were collected from test wells and analyzed by USGS for the pesticides reported to have been used at the site. One or more of the herbicides alachlor, atrazine, metolachlor and simazine were found in water from wells at five sites according to analyses by USGS. Soil samples collected from the surface to the water table at four of the sites were analyzed and typical results from two sites are reported. At both sites, the concentration of atrazine and metolachlor are similar at each depth of soil despite the fact that metolachlor is about 20-fold more soluble in water than atrazine. The results also show a distribution profile that is consistent with soil organic matter and clay content, particularly for atrazine and metolachlor, where the concentrations of the herbicides in the surface samples are much higher than those in the deeper samples. This distribution would also be expected since the herbicides are detected continuously in the soil from the surface to the water table at 7.5 ft. The presence of alachlor at the site in Simsbury is attributed to its use in previous years since it is often used in mixtures with atrazine and metolachlor at similar rates. This study strongly supports the earlier suggestion that herbicides retained throughout the soil profile following application constitute a potential for continued leaching to ground water. (Miller-PTT)
W89-12743

ALGAL METALLOTHIONEINS: SECONDARY METABOLITES AND PROTEINS.
Durham Univ. (England). Dept. of Biological Sciences.
N. J. Robinson.
Journal of Applied Phycology, Vol. 1, No. 1, p 5-18, April 1989. 1 fig, 1 tab, 79 ref.

Descriptors: *Chelating agents, *Metallothioneins, *Path of pollutants, *Metals, *Algae, Proteins, Metabolites, Detoxification.

The structure, biosynthesis and possible functions of metallothioneins (MTs) are discussed. MTs are

low-molecular-weight, cysteine-rich, polypeptides that complex 'soft' metal ions in thiol clusters. They are structurally diverse. Some MTs are gene products, while others are secondary metabolites. Two of the three classes of MT have been identified in algae. Eukaryotic algae possess the secondary metabolites referred to as class III MT. There is no unequivocal evidence that MT genes occur in eukaryotic algae. However, the products of MT genes have been identified in cyanobacteria. These genes and their metal regulatory elements remain to be isolated and characterized. MT's have attracted interest from researchers involved in a wide range of disciplines including bioinorganic chemistry, biochemistry, molecular biology, physiology, toxicology, environmental science and medicine. Although, the precise physiological roles of these polypeptides remain undefined, a large number of functions have been speculated. These molecules chelate toxic trace metals (such as Cd) and reduce the concentration of cytotoxic, free metal ions. Some Mt's are believed to be involved in zinc and copper homeostasis. (Author's abstract)
W89-12753

COMPARATIVE ANALYSIS OF POLYCHLORINATED DIBENZO-P-DIOXIN AND BIBENZOFURAN CONGENERS IN GREAT LAKES FISH EXTRACTS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY AND IN VITRO ENZYME INDUCTION ACTIVITIES.
Texas A and M Univ., College Station. Dept. of Veterinary Physiology and Pharmacology.
For primary bibliographic entry see Field 5A.
W89-12757

TRIBUTYLTIN IN BAY MUSSELS (MYTILUS EDULIS) OF THE PACIFIC COAST OF THE UNITED STATES.
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
J. W. Short, and J. L. Sharp.
Environmental Science and Technology ESTHAG, Vol. 23, No. 6, p 740-743, June 1989. 1 fig, 2 tab, 15 ref.

Descriptors: *Tributyltin, *Pesticides, *Tin, *Path of pollutants, *Coastal waters, *Atomic absorption spectrophotometry, *Mussels, Pacific coast.

Tissue concentrations of tributyltin (TBT) were measured by graphite furnace atomic absorption spectrophotometry (GFAA) and by gas chromatography coupled with an atomic absorption spectrophotometer as the detector (GCAA) in bay mussels (Mytilus edulis) collected from San Diego Bay (CA), Monterey Bay (CA), Puget Sound (WA), Auke Bay (AK), and Kodiak harbor (AK) in 1986 and 1987. Results from both methods were not significantly different ($P < 0.871$). Concentrations of TBT on mussels ranged from less than 0.005 microg of TBT/g of wet tissue weight to 1.08 microg/g of wet tissue weight. Concentrations of TBT in mussels sampled from Puget Sound were significantly lower ($P < 0.033$) in March 1987 than in June 1986, possibly due to the influence of boats freshly painted with marine antifoulants launched during the spring. The results may be useful as a benchmark to gauge the efficacy of recently enacted legislation restricting the use of marine antifoulants containing TBT on the Pacific coast of the United States. (Author's abstract)
W89-12758

LARGE COMMUNITY OUTBREAK OF CRYPTOSPORIDIOSIS DUE TO CONTAMINATION OF A FILTERED PUBLIC WATER SUPPLY.
Centers for Disease Control, Atlanta, GA.
For primary bibliographic entry see Field 5F.
W89-12764

NICKEL ABSORPTION AND KINETICS IN HUMAN VOLUNTEERS.
Connecticut Univ. Health Center, Farmington. School of Medicine.
F. W. Sunderman, S. M. Hopfer, K. R. Sweeney, A. H. Marcus, and B. M. Most.
Proceedings of the Society for Experimental Biology and Medicine PSEBAA, Vol. 191, No. 1, p 5-11, May 1989. 5 fig, 1 tab, 30 ref. EPA Cooperative Agreement CR813456-01.

Descriptors: *Biochemistry, *Path of pollutants, *Nickel, *Absorption, *Mathematical models, *Drinking water, Kinetics, Distribution.

Mathematical modeling of the kinetics of nickel absorption, distribution, and elimination was performed in healthy human volunteers who ingested NiSO4 drinking water (Experiment 1) or added to food (Experiment 2). Nickel was analyzed by electrothermal atomic absorption spectrophotometry in serum, urine, and feces collected during 2 days before and 4 days after a specified NiSO4 dose (12 microg of nickel/kg, n = 4; 18 microg of nickel/kg, n = 4; or 50 microg nickel/kg, n = 1). In Experiment 1, each of the subjects fasted 12 hr before and 3 hr after drinking one of the specified NiSO4 doses dissolved in water; in Experiment 2, the respective subjects fasted 12 hr before consuming a standard American breakfast that contained the identical dose of NiSO4 added to scrambled eggs. Kinetic analyses, using a compartmental model, provided excellent goodness-of-fit for paired data sets from all subjects. Absorbed nickel averaged 27 +/-17% (mean +/-standard deviation) of the dose ingested in water vs. 0.7 +/-0.4% of the same dose ingested in the food (a 40-fold difference. Rate constants for nickel absorption, transfer, and elimination were not significantly influenced by the oral vehicle. The elimination half-time for absorbed nickel averaged 28 +/-9 hr. Renal clearance of nickel averaged 8.3 +/-2.0 ml/min/1.73 sq m in Experiment 1 and 5.8 +/-4.3 ml/min/1.73 sq m in Experiment 2. It is confirmed that dietary constituents profoundly reduce the bioavailability of Ni(++) for alimentary absorption; approximately one-quarter of nickel ingested in drinking water after an over-night fast is absorbed from the human intestine and excreted in urine, compared with only 1% of nickel ingested in food. The compartmental model and kinetic parameters provided will reduce the uncertainty of toxicologic risk assessments of human exposures to nickel in drinking water and food. (Author's abstract)
W89-12765

UPTAKE AND BIOTRANSFORMATION OF 6,7-DIMETHYLQUINOLINE AND 6,8-DIMETHYLQUINOLINE BY RAINBOW TROUT (SALMO GAIRDNERI).
Enviro-Test Labs., Edmonton (Alberta).
D. A. Birkholz, R. T. Coutts, and S. E. Hrudey.
Xenobiotica XENOBH, Vol. 19, No. 7, p 695-710, 1989. 2 fig, 4 tab, 39 ref.

Descriptors: *Path of pollutants, *Accumulation, *Biotransformation, *Fish, *Trout, Quinolines, Absorption, Metabolites, Metabolism.

The uptake, elimination, and metabolism of two dimethylquinolines (DMQs), namely 6,7-DMQ and 6,8-DMQ in rainbow trout (Salmo gairdneri) are reported. It is apparent that both 6,7-DMQ and 6,8-DMQ are readily absorbed by fish tissue and metabolized. The major metabolites of 6,7-DMQ are two alcohols, resulting from the hydroxylation of each of the methyl groups in 6,7-DMQ. In contrast, the two major metabolites of 6,8-DMQ were the alcohol resulting from the hydroxylation of the 6-methyl group, and a phenol in which the OH group occupies the 3-, 5-, or 7-position of the quinoline ring. After depuration for up to 96 h, high levels (> 1000 microg/g) of metabolites were still present in the bile of fish exposed to these two DMQs. Since bioabsorbed metabolites are frequently the source of toxicity, such a finding may be cause for concern. (Miller-PTT)
W89-12766

AGRICULTURE AND GROUNDWATER QUALITY.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
H. Bouwer.
Civil Engineering (ASCE) CEWRA9, Vol. 59, No. 7, pp. 60-63, July 7, 1989.

Descriptors: *Water pollution sources, *Groundwater quality, *Agricultural chemicals, *Nitrates, *Pesticides, Fertilizers, Vadose water, Human pathology, Water quality standards, Water pollution prevention.

Agricultural nitrates and pesticides are the chemicals of concern in groundwater quality degradation. Nitrate-nitrogen concentrations in vadose zone water typically are in the range of 5 to 100 mg/l; maximum limit for drinking water is 10 mg/l. Ingestion of nitrates has been associated with methemoglobinemia or blue-baby disease, malignant tumors, heart disease and behavioral problems. EPA data indicates that of 45,000 wells tested, 5,500 had harmful levels of at least one pesticide, while another 5,500 had traces of 73 different pesticides in amounts not considered harmful. Ingestion of pesticide residues, or other contact, has been associated with cancer, nervous system disorders, birth defects, and male sterility. Several state and federal efforts are confronting the issue of water contamination and maximum permissible concentrations of toxic agricultural and other chemicals in groundwater and drinking water are being established. Prevention of groundwater pollution is cheaper than treating a problem. The author discusses prevention and treatment tactics. (Mertz-PTT)
W89-12771

OCCURRENCE OF BACTERIOPHAGES INFECTING BACTEROIDES FRAGILIS AND OTHER VIRUSES IN POLLUTED MARINE SEDIMENTS.
Barcelona Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W89-12780

VIRUSES IN RIVER WATER AND HEALTH RISK ASSESSMENT.
Medizinische Akademie 'Carl Gustav Carus' Dresden (German D.R.). Inst. fuer Allgemeine und Kommunale Hygiene.
R. Walter, H. Kaupa, M. Johl, J. Durkop, and U. Kramer.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 21-26, July 19, 1989. 3 fig, 1 tab, 9 ref.

Descriptors: *Water treatment, *Viruses, *Water pollution, *Public health, *Water conveyance, *Danube River, Austria, Environmental impact assessment, Canals.

The construction of the Marchfeldkanalsystem (Austria) creates irreversible environmental changes which could have an impact on environmental health. Virological investigations of the Danube River have been carried out as part of the environmental impact assessment procedure. The repeated detection of viruses in 61% of all water samples with a mean level of 0.762 MPN (most probable number)/L suggests that a permanent viral contamination of the Danube is occurring and that the self-purifying capacity of the river is relatively inefficient. Strains of some virus families not previously detected in water (toga-(bunya)viridae) could be found. Provided the proposed treatment facilities have a virus eliminating efficiency of 99.99%, the Marchfeldkanalsystem project will not endanger public health. (Author's abstract)
W89-12781

MINIMISATION OF MICROBIOLOGICAL HAZARDS ASSOCIATED WITH LATRINE WASTES.
Robens Inst. of Industrial and Environmental Health and Safety, Guildford (England).
For primary bibliographic entry see Field 5D.
W89-12783

AEROSOLIZED ENTERIC BACTERIA AND VIRUSES GENERATED BY SPRAY IRRIGATION OF WASTEWATER.
Hebrew Univ. of Jerusalem (Israel). Graduate School of Applie Science and Technology.
For primary bibliographic entry see Field 5E.
W89-12798

RECOVERY OF STAPHYLOCOCCI SPECIES FROM MARINE RECREATIONAL WATERS OF PUEBLA DE FARNALIS (VALENCIA, SPAIN).
Universidad Politecnica de Valencia (Spain). Dept. of Hydraulic and Environmental Engineering.
J. L. Alonso, I. Amoros, and E. Hernandez.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 239-241, July 19, 1989. 3 tab, 7 ref.

Descriptors: *Bioindicators, *Water pollution sources, *Recreation, *Coastal waters, *Staphylococcus, *Wastewater pollution, Antibiotic resistance, Spain, Wastewater outfall.

The occurrence of staphylococci in Spanish coastal waters was investigated to estimate their value as indicators of human presence and also to discover the resistance of various staphylococcal strains to antimicrobial drugs. The bacteria were sampled from two sites: Site 1 near a sewage disposal outfall, and Site 2 located 200 m from Site 1. The number of total staphylococci never exceeded that of bacteriological fecal indicators at the two sites. The greatest numbers of total staphylococci were found at Site 1, with a maximum count of 87,000/100 ml, while the counts at Site 2 were lower, with a maximum count of 6,200/100 ml, suggesting that the sewage effluent is the source of these bacteria. There was a strong correlation between total staphylococci and fecal indicators (r=0.78, significance level 1%) at Site 1. At Site 2 the correlation was less (r=0.46, significance level 5%). The six strains of Staphylococcus aureus tested were all resistant to at least one antimicrobial drug, and one strain was resistant to six. The major resistance was to penicillin antibiotics. The results suggest that total staphylococci may be a suitable indicator in evaluating marine water quality. (Sand-PTT)
W89-12813

DISTRIBUTION OF MESOPHILIC AEROMONADS IN TEMPERATE AQUATIC HABITATS: RELATIONSHIP WITH FAECAL INDICATORS.
Barcelona Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W89-12815

MICROBIOLOGICAL STUDY OF THE LAVOS COAST, PORTUGAL.
Laboratorio Nacional de Engenharia e Tecnologia Industrial, Lisbon (Portugal).
L. Baeta-Hall, P. S. Coelho, and M. C. Peneda.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 251-253, July 19, 1989. 4 fig, 5 ref.

Descriptors: *Water pollution sources, *Portugal, *Industrial wastewater, *Water quality, *Bacterial analysis, *Coliforms, *Streptococcus, Rainfall, Runoff, Seasonal variation, Lavos Coast, Wastewater outfall.

A study was conducted to determine the numbers of fecal pollution indicators and the related water quality levels along the Lavos Coast of Portugal. Fecal streptococci were present in the highest numbers, although high densities for fecal coliforms were also found at some sites 500 m from the shore. The site with the highest mean values of microorganisms was the site of an industrial wastewater discharge; therefore, the levels of fecal pollution indicators were probably related to the occurrence of these bacteria in the effluent. The study showed an extensive decrease in the counts of fecal indicator bacteria, due to dilution, at the other sites. The counts generally decreased by about 20% at 1000 m and 50% at 1500 m from the coast. Similar results were obtained for surface and bottom waters. At two sites, the high densities of total coliforms, fecal coliforms, and fecal streptococci were probably related to the presence in this area of a group of fishermen and the occurrence of some runoff. An analysis of the numbers of microbiological indicators observed during the period of the study showed that the high levels of total coliforms, fecal coliforms, and fecal streptococci observed in winter were related to the level of rainfall and the corresponding runoff from the soil. Increased mean values were also obtained during the summer. The high local rainfall and the large volume of freshwater entering the Atlantic Ocean were thought to be responsible for this. (Sand-PTT)
W89-12816

PRESENCE OF HUMAN AND ANIMAL VIRUSES IN SURFACE AND GROUND WATERS.
Institut Armand-Frappier, Laval (Quebec).
P. Payment.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 283-285, July 19, 1989. 1 fig, 1 tab.

Descriptors: *Animal wastes, *Water pollution sources, *Viruses, *Surface water, *Rivers, *Wastewater pollution, Reoviruses, Enteroviruses, Assomption River, Canada, Poultry, Groundwater pollution, Seasonal variation.

Animal enteroviruses, reoviruses and human enteric viruses were detected in a large number of water samples (20 L) from a major river system (Assomption river, Quebec, Canada). Animal enteroviruses, probably of porcine origin due to a massive pig raising activity in the area, were found in 29-60% of water samples from the river and 19-48% of the samples from the tributaries. The average concentration of these enteroviruses varied from 2-24 mpniu/L. Reoviruses, probably of avian (broiler chicken farms) or human origin (untreated domestic waste waters) were detected at the different sampling sites along the river in 19-52% of the samples at average concentrations of 5-24 mpniu/L. Human enteric viruses were detected in 13-72% of samples from the river and 14-71% of the samples from the tributaries. The average concentration of these human enteric viruses in the Assomption river varied from 1-12 mpniu/L and from 2-145 mpniu/L in the samples from the tributaries. Seasonal patterns were observed for all virus types with an increase in viral concentration in early fall. Two out of 22 samples of groundwater used as animal feed were also found to be contaminated by animal enteroviruses. (Author's abstract)
W89-12824

MICROBIOLOGICAL EXAMINATION OF OMI-EBO STREAM AND PIPEBORNE WATER SUPPLY IN ILE-IFE FOR POTABILITY.
Ife Univ. (Nigeria). Dept. of Microbiology.
For primary bibliographic entry see Field 5F.
W89-12829

FATE AND EFFECTS OF SALICYLIC ACID COMPOUNDS IN FRESHWATER SYSTEMS.
Academia Sinica, Beijing (China). Research Center for Eco-Environmental Sciences.
W. H. Wang, and J. P. Lay.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 3, p 308-316, June 1989. 3 fig, 4 tab, 19 ref.

Descriptors: *Salicylic acid, *Algae, *Daphnia, *Duckweed, *Biological magnification, *Fate of pollutants, Water pollution effects, Bioaccumulation, Aromatic compounds.

The comparative fates and effects of salicylic acid (SA) and Na salicylate in algae (Scenedesmus subspicatus, Monoraphidium minutum), in Lemna minor, and in Daphnia magna were examined using test methods based on the OECD testing guidelines with modifications in the procedures. The influence of fulvic acid (FA) on bioconcentration and on toxic effects was studied. FA addition significantly reduced the bioavailability of SA in L. minor and the algae species. SA was more toxic to Lemnaceae, algae, and daphnids than to its Na salt. Bioconcentration factors in S. subspicatus, M. minutum, and L. minor were about 1,000 in 72-96 hr. The reproducibility of D. magna was reduced by 38% at a concentration of 20 mg SA/liter. (Author's abstract)
W89-12838

RECOVERY OF BENTHIOCARB-INHIBITED ACHE IN FISH BRAIN: AN IN VITRO STUDY.
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
P. R. Aravinda Babu, G. Ramesh Reddy, G. R. Veera Babu, and C. S. Chetty.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 3, p 317-322, June 1989. 2 fig, 3 tab, 7 ref.

Descriptors: *Carbamate pesticides, *Acetylcholinesterase, *Fish, *Herbicides, *Water pollution effects, Enzymes, Benthiocarb.

The effects in vivo and in vitro of benthiocarb, an organocarbamate, on acetylcholinesterase (AChE) activity and its recovery in vitro in the brain of the freshwater fish Sarotherodon mossambicus were studied. Findings revealed that the specific activity of AChE was inhibited both in vivo and in vitro in a concentration-dependent manner. Of the different modulators tested, dexamethasone (0.72 mg), prednisolone (0.74 mg), testosterone (0.9 mg), and adenosine diphosphate (ADP) (9.50 mg) were found to neutralize the inhibitory effect (IC50=0.30 microM) of benthiocarb on AChE. The order of modulatory potentiality of the compounds tested, on the basis of EC50 values, was: dexamethasone > prednisolone > testosterone > ADP. (Author's abstract)
W89-12839

CONVENIENT MODEL AND PROGRAM FOR THE ASSESSMENT OF ABIOTIC DEGRADATION OF CHEMICALS IN NATURAL WATERS.
Hohenheim Univ., Stuttgart (Germany, F.R.).
R. Frank, and W. Kloepffer.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 3, p 323-332, June 1989. 1 tab, 21 ref.

Descriptors: *Degradation, *Computer models, *Fate of pollutants, Irradiation, Natural waters, Photolysis, Wastewater disposal, Hydrolysis.

A convenient model for the estimation and comparison of rates of various abiotic degradation processes of chemicals in natural waters is described. The estimates are obtained by combining spectral solar photon irradiances, relevant properties of natural waters, and physicochemical characteristics of the pollutants. The program can be operated by a microcomputer using BASIC computer language. The program system supplies the user with a set of spectral solar irradiances and allows the user to build up database files which contain the necessary properties of the natural waters and the chemicals. From this information, the rates of the various degradation processes and the half-lives of the chemicals in natural waters can be calculated for different times of the year. An example of model and program use is given for the calculation of the photochemical transformation of 2,4,6-trichlorophenol. (Geiger-PTT)
W89-12840

SAFETY ASSESSMENT OF BORON IN AQUATIC AND TERRESTRIAL ENVIRONMENTS.
Environmental Resources Ltd., London (England).
For primary bibliographic entry see Field 5C.
W89-12842

DISSIMILAR MICROBIAL HYDROCARBON TRANSFORMATION PROCESSES IN THE SEDIMENT AND WATER COLUMN OF A TROPICAL BAY (HAVANA BAY, CUBA).
Institute of Chemical Research, Havana (Cuba).
I. Ramos, M. Fuentes, R. Mederos, J. O. Grimalt, and J. Albaiges.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 6, p 262-268, June 1989. 3 fig, 4 tab, 31 ref. UNESCO/UNID Project No. CUB/80/001.

Descriptors: *Water pollution effects, *Hydrocarbons, *Cuba, *Oil pollution, *Aromatic compounds, *Marine sediments, *Fate of pollutants, Sedimentation, Microbial degradation.

A three year study of the effects of nutrients in sewage discharges on aquatic and sedimentary hydrocarbons in the Havana Bay, Cuba showed two

main microbially mediated processes of hydrocarbon transformation: one, in the water column, involving the bio-synthesis of C23-C30 n-, iso-and anteiso-alkanes from the spilled petroleum, and the other, in the sediments, consisting of the biodegradation of all n-alkanes. Mixtures of parent polynuclear aromatic hydrocarbons have also been found in the sediments, indicating contributions from high temperature combustion processes. The generally observed lack of correspondence between the hydrocarbon composition of the aquatic and sedimentary compartments seems to question the use of sediments for the assessment of petroleum pollution in semi-enclosed areas receiving high loads of anthropogenic inputs. (Author's abstract)
W89-12851

HELMINTH EGGS IN MARINE AND RIVER SEDIMENTS.
Nancy-1 Univ. (France). Faculte de Pharmacie.
J. Schwartzbrod, M. T. Thevenot, and J. L. Stien.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 6, p 269-271, 1 fig, 3 tab, 12 ref.

Descriptors: *Marine sediments, *Fluvial sediments, *Nematodes, *Parasites, *Water pollution sources, Sludge, Spain, Littoral zone, Path of pollutants.

The parasitological contamination of three types of sediments (fluvial sediment, marine sediment, and sewage sludge) of a specific coastal region off of Barcelona, Spain was examined. The region is fed by two highly polluted rivers (the Besos and the Llobregat) and an offshore conduit which discharges sewage sludge into the littoral marine environment. In the sludge, concentrations varied between 20 to 340 egg/kg with 30% of samples containing at least four different types of eggs (nematode and cestode eggs). In the river sediment, helminths eggs were found in 90% of the samples (sector Besos) and in 80% of samples (sector Llobregat). Only 20% of the littoral marine sediments from the Besos sector were positive for helminth eggs but in the sludge effluent zone all the samples were positive. At 7,000 m offshore no samples contained helminth eggs. In the Llobregat sector, 35% of the samples contained helminth eggs; there was no apparent difference in the degree of parasite contamination between the littoral (200 m offshore) and the intermediate zone (1,000 m offshore). At 4,000 and 12,000 m offshore no samples contained helminth eggs. The percentage of viable Ascaris eggs was always higher in the Besos sector than in the Llobregat sector. Some sediment marine samples contained viable Ascaris eggs: in the Besos sector 14% of viable Ascaris eggs were still found at 3,000 m and 4,000 m offshore while only samples collected from the littoral zone in the Llobregat sector contained 5% of viable Ascaris eggs. (Author's abstract)
W89-12852

OCCURRENCE OF CHLOROBENZENE ISOMERS IN THE WATER COLUMN OF A UK ESTUARY.
Water Research Centre, Medmenham (England).
H. R. Rogers, B. Crathorne, and T. M. Leatherland.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 6, p 276-281, June 1989. 2 fig, 3 tab, 8 ref.

Descriptors: *Chlorobenzenes, *Estuaries, *Scotland, *Water pollution sources, Hexachlorobenzene, Trichlorobenzene, Chlorinated hydrocarbons, Water column, Industrial wastes, Path of pollutants, Pollutant identification, Separation techniques.

Eleven chlorobenzene isomers in water column samples form the Forth Estuary, Scotland were concentrated by column chromatography and detected by gas chromatography with electron capture detection. The predominant isomers detected were 1,2,4-and 1,2,3-trichlorobenzene. Trichlorobenzenes (TCBs) were found at concentrations in the range 0.004-5.5 micrograms/liter, and chemical industry effluent, from a known user of trichlorobenzenes is thought to be the main source of these compounds to the estuary. Hexachlorobenzene was detected in all but one of the water samples collected at concentrations up to 196 nanograms/liter, with the other compounds generally occurring at lower or undetectable levels. The trichlorobenzenes are mainly derived from a single industrial effluent discharge, which is also a source of hexachlorobenzene. For hexachlorobenzene there may be contributions from other diffuse industrial and sewage effluent sources. (Author's abstract)
W89-12854

ACCUMULATION OF ORGANIC AND INORGANIC TIN IN BLUE MUSSEL, MYTILUS EDULIS, UNDER NATURAL CONDITIONS.
Marine Pollution Lab., Charlottenlund (Denmark).
C. Zuolian, and A. Jensen.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 6, p 281-286, June 1989. 7 fig, 1 tab, 25 ref.

Descriptors: *Tin, *Mytilus, *Bioaccumulation, *Organic compounds, *Path of pollutants, *Pesticides, *Biological magnification, Fate of pollutants, Depuration, Mussels.

The uptake of organic and total tin in the blue mussel, Mytilus edulis was followed under natural conditions in a marina contaminated with organic tin compounds released from antifouling paints used on pleasure boats. The accumulation of organic and total tin was studied over a period of 51 days with simultaneous sampling of seawater for organic and total tin analyses. The accumulation rate increased exponentially for both organic and total tin with decreasing concentration of tin in the seawater. Bioconcentration factors from 5,000-60,000 are much higher than found in other, similar studies performed in the laboratory. The half times for depuration of organic and total tin were 40 and 25 days, respectively. (Author's abstract)
W89-12855

DISTRIBUTION AND FRACTIONATION OF HEAVY METALS IN THE CAUVERY ESTUARY, INDIA.
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 5A.
W89-12856

ORGANOTIN COMPOUNDS IN HARBOUR AND MARINA WATERS FROM THE NORTHERN TYRRHENIAN SEA.
Siena Univ. (Italy). Dipt. di Biologia Ambientale.
E. Bacci, and C. Gaggi.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 6, p 290-292, June 1989. 1 fig, 1 tab, 7 ref.

Descriptors: *Tin, *Organic compounds, *Mediterranean Sea, *Italy, Harbors, Pollutant identification, Powerplants, Water pollution sources.

Selected sampling stations including two harbors, Leghorn and Piombino, and three marinas, Foce Cecina, San Vincenzo and Punta Ala in the Northern Tyrrhenian Sea were studied for organotin. Analysis of organotin compounds was by the simultaneous hydridization and extraction procedure. Results showed high and relatively constant levels of tributyltin (TBT) and dibutyltin (DBT) in Leghorn Harbor waters; organotins were not detected in the harbor at Piombino. Leghorn is a large harbor, with lower water turnover than Piombino harbor, and receives higher loads of organotin compounds from large ships, and from the effluent of TBT-treated cooling pipes of a thermoelectric powerplant. Concentrations of organotin compounds at marinas were high, due mostly to the high density of boats and to the shallowness of the water, and the low water turnover rate. No organotins were detected in open sea samples (detection limit of the method = 20 nanograms/liter for both TBT and DBT). (Geiger-PTT)
W89-12857

ELIMINATION OF SULPHUR COMPOUNDS FROM WASTEWATER BY THE ROOT ZONE PROCESS: II. MODE OF FORMATION OF SULPHUR DEPOSITS.
Gesamthochschule Kassel (Germany, F.R.). Dept. of Ecochemistry.
For primary bibliographic entry see Field 5D.
W89-12859

COMPARISON OF THE BIOSORPTION AND DESORPTION OF HAZARDOUS ORGANIC POLLUTANTS BY LIVE AND DEAD BIOMASS.
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
M. Tsezos, and J. P. Bell.
Water Research WATRAG, Vol. 23, No. 5, p 561-568, May 1989. 8 fig, 2 tab, 27 ref.

Descriptors: *Adsorption, *Desorption, *Fungi, *Activated sludge, *Wastewater treatment, *Pesticides, Biological wastewater treatment, Lindane, Diazinon, Pentachlorophenol, Chlorobiphenyl, Fate of pollutants, Biomass, Bioaccumulation, Organic compounds.

The adsorption and desorption of lindane, diazinon, pentachlorophenol and 2-chlorobiphenyl by living and dead cells of the fungus Rhizopus arrhizus and activated sludge was studied. Sorption and desorption experiments followed the standard activated carbon adsorption isotherm determination procedures, and organic pollutant concentrations were determined by electron capture gas chromatography. At 20 C and 5 C, the observed apparent uptake of lindane by both live biomass types was less than the respective uptake by the same dead cells. The observed pentachlorophenol uptake by live R. arrhizus was less than that observed for dead R. arrhizus. Diazinon was biosorbed by live R. arrhizus to approximately the same level as the dead biomass. Uptake by live activated sludge was similar to the uptake by dead sludge. The observed uptake of 2-chlorobiphenyl by live R. arrhizus was higher than the uptake by the same dead biomass. This result was also observed for uptake of 2-chlorobiphenyl by live activated sludge. Uptake of the four compounds examined in the present study onto dead biomass was correlated with the octanol/water partition coefficients of the compounds. Examination of the biosorption by R. arrhizus involved both uptake by the cell walls and by other cellular components. The biosorption of lindane by R. arrhizus may be completely reversible while partial irreversibility appears to be the case for other biosorption systems such as the pentachlorophenol/R. arrhizus and the 2-chlorobiphenyl/activated sludge systems. (Geiger-PTT)
W89-12860

ALGAL ASSAY OF RELATIVE ABUNDANCE OF PHYTOPLANKTON NUTRIENTS IN NORTHEAST UNITED STATES COASTAL AND SHELF WATERS.
National Marine Fisheries Service, Highlands, NJ. Sandy Hook Lab.
J. B. Mahoney.
Water Research WATRAG, Vol. 23, No. 5, p 603-615, May 1989. 5 fig, 2 tab, 63 ref.

Descriptors: *Algae, *Bioassay, *Eutrophication, *Coastal waters, *Water quality, *Limiting nutrients, Phosphorus, Nitrogen, Water quality, Diatoms, Spatial distribution, Temporal distribution, Water pollution effects, Phytoplankton, Silicon.

Regulation of phytoplankton growth by chemical water quality, in the coastal and shelf region between Cape Hatteras and the Gulf of Maine, was assessed by enrichment bioassay. Water sample collections, made in five surveys over an annual cycle, were assayed in the laboratory. The assay results, based on growth of a centric diatom, Thalassiosira pseudonana (clone 3H) Hasle and Heimdal, suggest that nitrogen, potentially, was the most important growth-limiting nutrient region-wide and year-round. The results also suggest that phosphorus had considerable importance and that silicon and vitamin B12 occasionally were limiting. The potential regulatory importance of phosphorus apparently was less consistent, temporally and spatially, than that of nitrogen. Phosphorus limitation was detected primarily in just two of the collections, from March and July surveys. In the March collection it was evident predominantly in the in-

shore samples, but in the July collection its incidence was approximately the same among samples from inner, mid and outer shelf. Inhibitory water quality was prevalent in two of the collections, particularly in samples from inshore locales. The cause of this inhibition has not been identified but it was not associated with nutrient concentration. It is possible that adverse water quality was an important growth regulator in the region, at least for species having sensitivities analogous to that of the assay organisms. (Author's abstract)
W89-12865

REMEDIAL INVESTIGATION OF AN ORGANICALLY POLLUTED OUTWASH AQUIFER.
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5G.
W89-12875

CONCENTRATIONS OF CD, SR, AND U IN FISH AND WATER SAMPLES COLLECTED FROM A SMALL STREAM RECEIVING URANIUM MINE DRAINAGE.
Turnbull Lab. for Ecological Studies, Cheney, WA.
D. G. Nichols, and A. T. Scholz.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 1, p 13-25, June 1989. 1 fig, 4 tab, 23 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Heavy metals, *Uranium, *Fish, *Mine drainage, Industrial wastes, Midnite Uranium Mine, Blue Creek, Washington, Metals, Water pollution, Cadmium, Strontium, Trout.

The concentrations of cadmium, strontium and uranium were determined in whole eviscerated rainbow trout, trout liver, and water samples collected from Blue Creek, Washington, which receives drainage from a uranium mine. Average water concentrations of the metals downstream of the mine discharge increased 15-fold for Cd, 5-fold for Sr, and 100-fold for U during both high and low streamflow. Average Cd concentrations in water for the impacted area were 2.29 microgram/liter during high flow and 1.46 microgram/liter during low flow. The weighted average Cd concentrations in whole fish for the impact area were 0.26 and 0.44 microgram/g dry weight for high and low flow periods, respectively. Average liver Cd levels were 2.05 microgram/g dry weight in high flow conditions. Average Sr levels in water during high and low flow were 192 and 371 microgram/g, respectively. Sr concentrations in fish and liver were actually higher in the preimpact region of the stream than in the impacted area. Average uranium levels in water were 166 microgram/g during the low flow period. The weighted average U concentrations in fish were 0.67 and 0.58 microgram/g dry weight in high flow and low flow conditions, respectively. Uranium levels in liver were increased immediately downstream from the discharge under low flow conditions but were similar to those in control streams in other locations. (Cassar-PTT)
W89-12950

UPTAKE OF HEAVY METALS BY UNICELLULAR GREEN ALGAE CLOSTERIUM MONILIFERUM (BORYL) EHRENB.
Banaras Hindu Univ., Varanasi (India). Centre for Advanced Study in Botany.
B. R. Chaudhary, and P. S. Sastry.
Phykos PHKSBF, Vol. 27, No. 1-2, p 140-145, 1988. 1 tab, 18 ref.

Descriptors: *Bioaccumulation, *Path of pollutants, *Phytoplankton, *Heavy metals, Nickel, Chromium, Algae, Closterium moniliferum, Chlorophyta, Accumulation, Bioaccumulation, Metals.

Nickel and chromium were added to cultures of the green alga Closterium moniliferum at sublethal concentrations and the uptake studied as a function of time. No uptake was seen at a metal concentration of 1 ppm for 6 hr exposure. The absorption of nickel from the nutrient medium at 2 ppm was negligible at 6 hr and 25.0% at 72 hr; at 4 ppm, 2.67% at 6 hr and 19.67% at 72 hr; at 5 ppm, 3.60% at 6 hr and 19.80% at 72 hr. The absorption of chromium from the nutrient medium at 0.1 ppm was 10% at 12 hr and 80% at 72 hr; at 0.5 ppm, 4% at 12 hr and 44% at 72 hr; at 1.0 ppm, 15% at 12 hr and hr, 8% at 24 hr, 19% at 48 hr, and 16% at 72 hr. (Cassar-PTT)
W89-12970

PHYCOLOGICAL AND PHYSICOCHEMICAL EVALUATION OF THE RIVER AYAD, UDAIPUR.
Sardar Patel Univ., Kaira (India). Dept. of Biosciences.
B. C. Rana, and S. Palria.
Phykos PHKSBF, Vol. 27, No. 1-2, p 211-217, 1988. 1 fig, 2 tab, 22 ref.

Descriptors: *Path of pollutants, *Rivers, *Water quality, *Phytoplankton, Algae, Water pollution, Ayad River, India.

The River Ayad in India was monitored for physicochemical and phycological changes during 1980 and 1981. This channel receives domestic and industrial wastes. It is nearly dry during April to June. Stations sampled included a site upstream of the city discharges (1), stations receiving the bulk of municipal wastes (2 and 3), a site downstream of a distillery (4), and a downstream rural station receiving agricultural runoff (5). Water quality parameters indicated that stations 2, 3, and 4 were grossly polluted. The algal communities here were dominated by pollution tolerant blue-green algae. Stations 1 and 5, less polluted, harbored more diverse forms and included both pollution tolerant and freshwater species. Algae at stations 2 and 3 included Merismopedia, Oscillatoria, Arthrospira, Phormidium, and Scenedesmus. Algae at station 4 (distillery wastes) were those characteristic of water with high organic content, Oscillatoria, Spirulina subsalsa, Ankistrodesmus fulcata, Scenedesmus quadricauda, Euglena gracilis, Nitschia amphibia, and N. sigma. According to Palmer's index of pollution, the stations were rated as follows: station 1, 12; stations 2 and 3, 14; station 4, 25; and station 5, 18. (Cassar-PTT)
W89-12971

CIRCULAR CONVECTION DURING SUBSURFACE INJECTION OF LIQUID WASTE, ST. PETERSBURG, FLORIDA.
Geological Survey, Tampa, FL.
For primary bibliographic entry see Field 5E.
W89-12975

MODIFIED METHOD OF CHARACTERISTICS TECHNIQUE AND MIXED FINITE ELEMENTS METHOD FOR SIMULATION OF GROUNDWATER SOLUTE TRANSPORT.
Shell Development Co., Houston, TX.
C. Y. Chiang, M. F. Wheeler, and P. B. Bedient.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1541-1549, July 1989. 6 fig, 37 ref.

Descriptors: *Groundwater movement, *Solute transport, *Path of pollutants, *Mathematical models, *Model studies, *Groundwater pollution, Finite element method, Mathematical analysis, Groundwater movement.

A comprehensive groundwater solute transport simulator was developed based on the modified method of characteristics (MMOC) combined with the Galerkin finite element method for the transport equation and the mixed finite element (MFE) method for the groundwater flow equation. The preconditioned conjugate gradient algorithm was used to solve the two large sparse algebraic system of equations arising from the MMOC and MFE discretizations. The MMOC takes time steps in the direction of flow, along the characteristics of the velocity field of the total fluid. The physical diffusion and dispersion terms are treated by a standard finite element scheme. The crucial aspect of the MMOC technique is that it looks backward in time, along an approximate flow path, instead of forward in time as in many method of characteristics or moving mesh techniques. The MFE procedure involves solving for both the hydraulic head and the specific discharge simultaneously. One order of convergence is gained by the MFE methods, as compared with other standard finite element methods, and herefore more accurate velocity fields are simulated. The overall advantages of the MMOC-MFE method include minimum numerical oscillation or grid orientation problems under steep concentration gradient simulations. Material balance errors are greatly reduced due to a very accurate velocity simulation by the MFE method. Much larger time steps with Courant number well in excess of 1, as compared with the standard Galerkin finite element method, can be taken on a fixed spatial grid system without significant loss of accuracy. (Author's abstract)
W89-12981

GROUNDWATER TRAVEL TIME UNCERTAINTY ANALYSIS USING SENSITIVITY DERIVATIVES.
INTERA Technologies, Inc., Austin, TX.
M. La Venue, R. W. Andrews, and B. S. RamaRao.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1551-1566, July 1989. 15 fig, 2 tab, 40 ref.

Descriptors: *Path of pollutants, *Radioactive waste disposal, *Hazardous materials, *Groundwater pollution, *Groundwater movement, Model studies, Permeability, Deaf Smith County, Texas, Traveltime, Stochastic process.

Groundwater travel time is a key performance measure used in the performance assessment of a potential site for the storage of high-level radioactive waste. Two approaches commonly used to quantify the uncertainty in a given prediction of a performance measure are the first-order second-moment (FOSM) approach and the stochastic approach. The FOSM approach predicts the mean and variance of the performance measure based on the mean and variance of the system parameters (e.g., permeability, porosity) and the sensitivity of the performance measure with respect to the system parameters. The sensitivity of the performance measure is directly determined by calculating its first derivative with respect to selected system parameters. The uncertainty of the performance measure is then calculated by multiplying the performance measure sensitivity to the uncertainty of the system parameters. The FOSM approach has been employed to determine the uncertainty of the predicted groundwater travel time performance measure at the proposed high-level waste (HLW) repository site that had been undergoing detailed investigation in Deaf Smith County, Texas. The results are compared to a similar study using the stochastic approach. The results from both approaches were very similar in this application. The FOSM approach is also used to predict changes in the mean groundwater travel time for selected changes in permeability values within the model. For changes in permeability of one half standard deviations or less, additional simulations are not required in order to reasonably predict the change in the groundwater travel time using FOSM. For perturbations of approximately one standard deviation FOSM does not provide a reasonable prediction of the change in groundwater travel time. These results indicate the stochastic approach should be used when the variance or uncertainty of the hydrogeologic parameters is high because of the limitation on the perturbation of these parameters in the FOSM approach. (Author's abstract)
W89-12982

FIELD SCALE TRANSPORT OF BROMIDE IN AN UNSATURATED SOIL. 1. EXPERIMENTAL METHODOLOGY AND RESULTS.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. L. Butters, W. A. Jury, and F. F. Ernst.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1575-1581, July 1989. 5 fig, 4 tab, 20 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Model studies, *Aeration zone, *Soil solution, *Leaching, *Tracers, Sprinkler irrigation, Irrigation, Bromides, Monitoring, Solute transport.

The movement of a mobile tracer (Br(-)) was monitored as it moved through the unsaturated zone beneath the soil surface of a 0.64 ha loamy sand field. Under flux-controlled, steady state water flow achieved by sprinkler irrigation, a narrow pulse of 58.9 mol/cu m aqueous NaBr was applied uniformly to the field and subsequently leached downward while monitored by vacuum solution samplers replicated 16 times at each of 6 depths between 0.3 and 3.0 m and 6 times at the 4.5 m depth. Six deep soil cores to a maximum of 25 m were taken to characterize the final field average bromide depth profile after the pulse had passed the 4.5 m depth. Although the mass recovery of the area-averaged pulse was near 100% at all depths, the coefficient of variation (CV) of mass recovery between samplers at a given depth was near 50%. Lateral variations in apparent vertical solute velocity or in solute transport volume were considerable with CVs near 50% in the shallow monitoring depths. However, variations in transport volume with depth at a given site were also large, even though the solution samplers for different depths were displaced laterally by only 0.3-0.6 m at different sites. The mean vertical velocity of the area-averaged solute pulse was significantly less than the ratio of the average net water flux to the average volumetric water content, until approximately 1.8 m. The difference between the two average velocities near the surface was large enough (nearly a factor of 2) to suggest that transient effects from the irrigation were influencing solute transport. (See also W89-12985) (Author's abstract)
W89-12984

FIELD SCALE TRANSPORT OF BROMIDE IN AN UNSATURATED SOIL. 2. DISPERSION MODELING.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. L. Butter, and W. A. Jury.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1583-1589, July 1989. 5 fig, 2 tab, 32 ref.

Descriptors: *Groundwater movement, *Dispersion, *Path of pollutants, *Aeration zone, *Vadose water, *Soil solution, *Model studies, *Solute transport, *Tracers, Bromides, Soil texture.

The solute concentrations measured in a field experiment were used to compare two models of vadose zone solute transport: the deterministic one-dimensional convection-dispersion model, which represents solute transport far from the source of solute entry, and the stochastic-convective lognormal transfer function model, which represents solute transport near the source. The stochastic-convective model provided an excellent representation of the spreading of the solute pulse to a depth of 3 m after calibration at 0.3 m. The deterministic model dramatically underpredicted solute spreading beyond 0.3 m after calibration. An analysis of the area-averaged solute concentration revealed a nearly linear scale effect in the dispersivity to a depth of at least 14.8 m. A change in the growth pattern of dispersion observed in the breakthrough curve at 4.5 m was attributed to a soil texture change near 3 m, which caused the apparent dispersivity of the pulse to decrease between 3.0 and 4.5 m, after which it increased significantly between 4.5 m and the final profile sampling between 0 and 25 m. (Author's abstract)
W89-12985

MASS RESPONSE FUNCTIONS.
Trento Univ. (Italy). Dept. of Engineering.
A. Rinaldo, A. Marani, and A. Bellin.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1603-1617, July 1989. 7 fig, 35 ref.

Descriptors: *Soil water, *Unsaturated flow, *Path of pollutants, *Solute transport, *Stochastic models, *Nonpoint pollution sources, Traveltime, Groundwater pollution, Model studies, Statistical models, Runoff, Nitrates, Ai River.

Field transport of reactive solute species was investigated through a class of stochastic models, termed mass response functions (MRFs), which incorporate simplified concepts of chemical/physical nonequilibrium kinetics in the formulation of transport by travel time distributions. MRFs are probability density function (pdfs) associated with solute particles' travel time within transport volumes. The relationship between MRFs and the theory of solute transport by continuous motions was also investigated. MRFs extend the basic formulation of transport of inert solutes to a particular case of sorption process. Investigation of the relationship between MRFs and the basic differential convection-dispersion equation incorporating linear sorption showed that not only are transfer functions of solutes consistent with any mechanistic three-dimensional (3-D) model of convection dispersion, but also that they are, under limit conditions, the product of travel time distribution of the carrier flow with a bounded continuous function. Travel time distributions and MRFs underlain by statistical-mechanical tools are proposed. Non-Gaussian distributions were studied by statistical-mechanical tools and found to represent the norm, rather than the exception, in this formulation of transport of reactive solutes. The concepts were applied to a field study which dealt with extensive data gathered in the small Japanese catchment of the upper Ai river for basin wide solute nitrate-N circulation. The findings indicated that the high content of nitrate-N load to river water during floods was not brought in by rain or surface runoff, but by the discharge once in contact with the topsoil which turned out to be the sole significant source of solute nitrate-N supply. The application of MRF to this field study revealed its reliability and robustness for application to nonpoint pollution problems. (Peters-PTT)
W89-12987

SPECIATION AND EQUILIBRIUM RELATIONS OF SOLUBLE ALUMINUM IN A HEADWATER STREAM AT BASE FLOW AND DURING RAIN EVENTS.
Geological Survey, Reston, VA.
D. A. Burns.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1653-1665, July 1989. 7 fig, 6 tab, 77 ref.

Descriptors: *Acid rain effects, *Aluminum, *Speciation, *Water pollution sources, *Acidic water, *Soil water, Surface-groundwater relations, Surface water, Model studies, Streams, Rainfall, Precipitation, Shenandoah National Park, Virginia, Pollutant identification.

In a small watershed in the Shenandoah National Park, Virginia, the short-term dynamics of soluble aluminum in stream water sampled during rain events differed significantly from stream water sampled during base flow conditions. Three fractions of dissolved aluminum were measured. The inorganic monomeric fraction made up approximately two thirds of the total reactive aluminum at base flow, followed by the acid-soluble and organic monomeric fractions, respectively. Equilibrium modeling showed that hydroxide complexes were the most abundant form of inorganic monomeric aluminum followed by fluoride, free aluminum ion, and sulfate. The activity of inorganic monomeric aluminum at base flow appears to be in equilibrium with an Al(OH)3 phase with solubility intermediate between microcrystalline gibbsite and natural gibbsite. During two rain events, the concentration of all three aluminum fractions increased significantly. The primary cause of the transient increase in the Al(OH)3 saturation index appears to have been the neutralization of excess H(+) added by soil water through reaction with stream water HCO(-3) at a more rapid rate than excess inorganic monomeric aluminum could be removed from solution by hydroxide mineral precipitation. A soil water/stream water mixing model was developed based on measured changes of stream water alkalinity, silica concentration, and charge imbalance during the rain events. Model results indicate that a small amount of soil water (3-11%) was present in the stream at peak stage. (Author's abstract)
W89-12991

HYDROLOGIC CONTROL OF SULFATE MOBILITY IN A FORESTED WATERSHED.
Pennsylvania State Univ., University Park. Forest Resources Lab.
J. A. Lynch, and E. S. Corbett.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1695-1703, July 1989. 5 fig, 6 tab, 26 ref.

Descriptors: *Path of pollutants, *Sulfates, *Fate of pollutants, *Forest watersheds, *Acid rain effects, *Pennsylvania, Dry deposition, Storm runoff, Seasonal variation, Water pollution, Streams, Soil properties, Watersheds, Hydrologic properties.

Five years of atmospheric wet sulfate deposition and stream sulfate export data were evaluated to determine the fate and mobility of sulfate in a forested watershed in central Pennsylvania. Sulfate concentrations in stream water were inversely related to sulfate concentrations in precipitation. Sulfate export from this watershed exceeded wet deposition by approximately 20% in 4 out of the 5 years studied, indicating an additional source of sulfate, possibly dry deposition. The average sulfate export from this watershed during February through May was 69.8% of the total annual export. The fact that sulfate export during this 4-month period could not result from wet deposition during this period suggests that atmospherically deposited sulfate is temporarily stored on the watershed and that the release of this stored sulfate is controlled by the hydrologic responsiveness of the watershed. Analysis of both monthly and storm flow sulfate export/input data supports these conclusions and suggests that the release of stored sulfate can be described by the variable source area concept. The results also suggest that the sulfate adsorption capacity of the soils on this watershed has been satisfied and that a steady state condition exists between atmospheric sulfate inputs and export. Because hydrologic conditions appear to control sulfate export significantly, multiple years of record are required when using the watershed mass balance technique to estimate dry deposition or determine the status of sulfate adsorption on a basin. It is recommended that at least 3-5 years of input/export data be used when using this technique. (Author's abstract)
W89-12995

BOUNDARY AND INTERFACE CONDITIONS IN POROUS MEDIA.
CyberLink Corp., Boulder, CO.
For primary bibliographic entry see Field 2F.
W89-12996

MODEL FOR HYSTERETIC CONSTITUTIVE RELATIONS GOVERNING MULTIPHASE FLOW 3. REFINEMENTS AND NUMERICAL SIMULATIONS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 2G.
W89-12998

TWO-DIMENSIONAL TRANSPORT AND FATE OF CHEMICALS EMITTED BY ARBITRARILY PLACED SOURCES IN CONFINED AQUIFERS.
Oregon State Univ., Corvallis. Dept. of Soil Science.
F. T. Lindstrom, and L. Boersma.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1748-1756, July 1989. 8 fig, 3 tab, 7 ref.

Descriptors: *Model studies, *Mathematical models, *Fate of pollutants, *Path of pollutants, *Groundwater pollution, *Aquifers, Confined aquifers, Model studies, Soil properties.

A two-dimensional mathematical model (TWODIMPL) describes the advective-dispersive transport and the transformations of chemicals leaking into confined aquifers. Linear equilibrium rules are assumed to apply to the sorbing soil components made up of weakly sorbing and strongly sorbing fractions and an organic matter fraction. First-order or zero-order loss rates of compound due to microbial or other irreversible loss processes are included. Aquifers of rectangular shape and infinite in the transverse dimensions with constant strength

sources of chemical, emitting uniformly across the finite vertical aquifer thickness are assumed. The linear parabolic transport equation was solved via the classical Green's function approach. The spatial distribution of chemical concentration at any time derived from any and all distributed sources is given as a time convolution integral. The integral is approximated numerically by a specialized Simpson's quadrature procedure. Three scenarios, chosen for realism of field conditions, were used to demonstrate the application of the model: (1) leaking underground storage drums, (2) a problem where a non-zero initial distribution of chemical in the free phase is approximated by a combination of nine individual rectangular cells, and (3) pollutant concentration fields that result from multiple sources. Important assumptions underlying the model are that the model was developed for a saturated, homogeneous, and isotropic medium. Application for conditions where these assumptions are not met should be made with care. (Peters-PTT)
W89-13000

TRANSPORT OF DISSOLVED SUBSTANCES WITH SECOND-ORDER REACTION.
Agricultural Research Service, Riverside, CA. Salinity Lab.
S. R. Yates, and C. G. Enfield.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1757-1762, July 1989. 6 fig, 26 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Groundwater pollution, *Mathematical models, *Fate of pollutants, Numerical analysis.

A mass transport equation which allows coupled second-order reaction between two chemical components in groundwater systems is described. Several analytical solutions to the system of nonlinear equations for advective flow systems have been found, and the features of the solution are illustrated. The combined effects of hydrodynamic dispersion and second-order reaction were investigated using a numerical technique, since analytical solutions which allow dispersion were not found. The analytical solutions can be used in the verification of numerical solution techniques especially in advection-dominated transport regimes and can be used to give insight into how the second-order reaction mechanism affects the transport and fate process. The solutions can also be used to determine the second-order reaction coefficient from batch reactor or advective flow experiments. (Author's abstract)
W89-13001

OXYGEN CONSUMPTION, NEW PRODUCTION, VERTICAL ADVECTION AND ENVIRONMENTAL EVOLUTION IN THE MEDITERRANEAN SEA.
Paris-6 Univ. (France). Lab. de Physique et Chimie Mariens.
For primary bibliographic entry see Field 5C.
W89-13007

ENVIRONMENTAL CRISIS IN INDIA: A CASE STUDY OF PUNJAB.
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Landschaftsoekonomie.
G. Singh.
Environmental Education & Information EEDIEF, Vol. 8, No. 1, p 31-41, January-March 1989. 1 fig, 1 tab, 7 ref.

Descriptors: *Environmental policy, *Resources management, *Conservation, *Long-term planning, *Water pollution sources, *Flooding, *Agriculture, *India, *Groundwater pollution, *Groundwater level, Irrigation, Saline soils, Leaching, Brackish water, Hydrologic budget, Government supports, Erosion, Public policy, Economic aspects, Natural resources, Resources development.

The major environmental concern in Punjab is not so much the pollution of natural resources as their degradation or depletion. The Punjab has lost more than 30% of its trees during the last 7 yr. This has resulted in increased flooding and soil erosion. Due to low and irregular rainfall, the southwestern parts of Punjab are subject to wind erosion.l Punjab has been using water more rapidly than it is being replaced by hydrological recharge. This has resulted in declining water tables, leaching and salinization of soils, plus the construction of a canal system for irrigation. The canal irrigation has disturbed the water balance and created soil salinization and water logging problems. Groundwater in some districts is brackish and unfit for irrigation. Industrial effluents , municipal wastewater, and agricultural runoff have contaminated groundwater and surface water. It is necessary to introduce an environmental policy into planning and development processes along with effective conservation measures and the rational use of natural resources. It is particularly important that long-term considerations should prevail over short-term commercial considerations. Technical and financial assistance from the government in setting up monitoring programs will be an immense help in assessing and forecasting local pollution and checking accidental environmental catastrophes. These problems will be solved by improving waste disposal methods, recycling, greater control of pollution at the source, better location of pollution-generating activities, and installation of treatment plants. (Sand-PTT)
W89-13008

KARST CONTAGION MODEL: SYNOPSIS AND ENVIRONMENTAL IMPLICATIONS.
Austin Peay State Univ., Clarksville, TN. Dept. of Geology and Geography.
For primary bibliographic entry see Field 2F.
W89-13010

EFFECTS OF LAND USE ON THE WATER QUALITY AND BIOTA OF THREE STREAMS IN THE PIEDMONT PROVINCE OF NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
J. K. Crawford, and D. R. Lenat.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4007, July 1989. 67p, 3 fig, 25 tab, 102 ref.

Descriptors: *Water quality, *Water pollution sources, *Stream water quality, *Land use, *Stream biota, *North Carolina, Piedmont streams, Macroinvertebrates, Fish, Nutrients, Metals, Suspended sediment, Bottom sediment chemistry, Interstitial water.

Three small streams in North Carolina's northern Piedmont were studied to compare the effects of land use in their watersheds on water quality characteristics and aquatic biota. Devil's Cradle Creek (agricultural watershed) had more than two times the sediment yield of Smith Creek (forested watershed) (0.34 tons/acre compared to 0.13 tons/acre), and Marsh Creek (urban watershed) had more than four times the yield of Smith Creek (0.59 tons/acre). Concentrations of nutrients were consistently highest in Devil's Craddle Creek. Concentrations of total copper, iron, and lead in samples from each of the three streams at times exceeded State water quality standards as did concentrations of total zinc in samples from both Smith and Marsh Creeks. Successively lower aquatic invertebrate taxa richness was found in the forested, the agricultural, and the urban watershed streams. Invertebrate biota in Smith Creek was dominated by insects, such as Ephemeroptera, that are intolerant to stress from pollution, whereas Devil's Cradle Creek was dominated by the more tolerant Diptera, and Marsh Creek was dominated by the most pollution-tolerant group, the Oligochaeta. Fish communities in the forested and agricultural watershed streams were characterized by more species and more individuals of each species, relative to a limited community in urban Marsh Creek. Three independent variables closely linked to land use--suspended-sediment yield, suspended-sediment load, and total lead concentrations in stream water--are inversely associated with the biological communities of the streams. (USGS)
W89-13013

MAPPING PESTICIDE CONTAMINATION POTENTIAL.
Hawaii Univ. at Manoa, Honolulu. Dept. of Agricultural Engineering.
M. A. Khan, and T. Liang.
Environmental Management EMNGDC, Vol. 13, No. 2, p 233-242, March-April 1989. 6 fig, 4 tab, 22 ref. USDA Grant CSRS-2-2152.

Descriptors: *Groundwater pollution, *Pesticides, *Mapping, *Geographic information system, Contamination potential index, Computer models, Licensing.

The problem of assessing nonpoint source pollution by agricultural pesticides was addressed using a spatial analysis and mapping system to evaluate groundwater contamination potential of a large number of pesticides for a large tract of land quickly and economically. A contamination potential index was employed for preliminary assessment. A specially designed geographic information system was used to create groundwater contamination likelihood maps for a 1500 sq km area. Maps similar to these can be used to indicate protection priorities in conjunction with groundwater classification and management systems. Repeated analyses can be made rapidly for varying chemical properties and changing criteria of pesticide contamination potential for the decision making process. Thus, this technique provides a means of assessing the potential damage by pesticides to the environment before pesticides are licensed for use in agriculture. (Author's abstract)
W89-13017

CONCENTRATIONS OF TWO ORGANIC CONTAMINANTS IN PRECIPITATION, SOILS, AND PLANTS IN THE ESSEX REGION OF SOUTHERN ONTARIO.
Windsor Univ. (Ontario). Great Lakes Inst.
M. Sanderson, and I. M. Weis.
Environmental Pollution ENPOEK, Vol. 59, No. 1, p 41-54, 1989. 2 fig, 3 tab, 24 ref. Natural Sciences and Engineering Research Grant A4880; Environmental Canada Contract UP-G175.

Descriptors: *Air pollution, *Path of pollutants, *Polychlorinated biphenyls, *Chlorinated hydrocarbons, *Precipitation, *Soil types, *Plant tissues, Octachlorostyrene, Urban areas, Suburban areas, Rural areas, Ontario, Canada, Great Lakes Basin.

Recent research has indicated that the atmosphere is an important pathway by which pollutants enter terrestrial and aquatic ecosystems. This study reports concentrations of PCBs and octachlorostyrene (OCS) in precipitation, soils and plants in Essex County, Ontario. The average PCB concentration in urban precipitation (23 ng/L) was lower than that previously reported for urban areas in the Great Lakes basin. Differences between sites and with varying wind directions were not significant. OCS concentrations in precipitation averaged 1.6 ng/L. Concentrations of PCBs in soils were 2-3 orders of magnitude greater than in precipitation. Concentrations of these pollutants in city soils and plant roots were consistently higher than those from suburban and rural sites. Ratios of urban to suburban concentrations in soils and precipitation were approximately 5:1 for PCBs. However, concentrations of OCS were similar in urban and suburban samples of precipitation, soils and plant tissue. These comparisons suggest an urban source for PCBs, but not OCS. Concentrations of all contaminants in plant leaves, unlike those in precipitation, roots and soils, were relatively similar in urban and suburban areas. That similarity suggests that direct foliar uptake is not an important pathway for pollutant uptake in plants. (Author's abstract)
W89-13019

DETERMINANTS OF DRINKING WATER QUALITY IN RURAL NICARAGUA.
Instituto Nicaraguense de Acueductos y Alcantarillados, Managua.
P. Sandiford, A. C. Gorter, G. D. Smith, and J. P. C. Pauw.
Epidemiology and Infection EPINEU, Vol. 102,

No. 3, p 429-438, June 1989. 1 fig, 4 tab, 26 ref.

Descriptors: *Drinking water, *Contamination, *Coliforms, *Water quality, *Nicaragua, Rural areas, Rainfall, Wells, Pipes, Springs, Water storage, Diarrhea, Developing countries, Human diseases.

Water samples (103) from rural Nicaragua were examined for the presence of fecal coliforms during both wet and dry periods. A linear model was fitted by analysis of covariance with the logarithm of the fecal coliform count as the dependent variable. As expected, traditional water sources were grossly contaminated at all times whereas piped water sources were much cleaner. Hand-dug protected wells had significantly higher levels of fecal contamination than unprotected riverside wells and springs during the dry season. The possible reasons for this unexpected finding are discussed. A close association between rainfall and fecal contamination was demonstrated but the affect of rainfall depended on the type of water source. An association between water quality and the size of the community served by the source was also detected. The finding that stored water was usually more contaminated than fresh water samples is consistent with the results from other studies. Since it is unusual for water quality to be inversely correlated with accessibility, this study site would be suitable for investigating the relative importance of water-borne versus water-washed transmission mechanisms in childhood diarrhea. (Author's abstract)
W89-13021

DIETARY ABSORPTION EFFICIENCIES AND ELIMINATION RATES OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN RAINBOW TROUT (SALMO GAIRDNERI).
Canada Centre for Inland Waters, Burlington (Ontario).
A. J. Niimi, and G. P. Dookhran.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 8, p 719-722, 1989. 2 tab, 23 ref.

Descriptors: *Polycyclic aromatic hydrocarbons, *Trout, *Fate of pollutants, *Bioaccumulation, Metabolism, Dietary absorption, Fish physiology, Absorption.

Dietary absorption efficiencies and elimination rates of acenaphthalene, 1-phenylnaphthalene, 2-methylanthracene, 9-methylanthracene, triphenylene, perylene, benzo(a)fluorene, dibenzo(a,h)anthracene, benzo(ghi)perylene and coronene were examined in rainbow trout. Subadult fish were exposed to 10 mg of each chemical over 5 d and polycyclic aromatic hydrocarbon (PAH) levels were monitored during the following 25 d. The results indicated that PAHs were not accumulated by trout through dietary exposure because of the combined effects of poor absorption efficiencies and rapid elimination rates. Phenylnaphthalene was more persistent than the other PAHs examined, with a half-life of 25 d. (Author's abstract)
W89-13026

ADAPTATION TO A QUATERNARY AMMONIUM SURFACTANT BY SUSPENDED MICROBIAL COMMUNITIES IN A MODEL STREAM.
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
For primary bibliographic entry see Field 5C.
W89-13027

MICROBIAL BIOMASS AND ACTIVITIES ASSOCIATED WITH SUBSURFACE ENVIRONMENTS CONTAMINATED WITH CHLORINATED HYDROCARBONS.
Tennessee Univ., Knoxville. Inst. for Applied Microbiology.
T. J. Phelps, D. Ringelberg, D. Hedrick, J. Davis, and C. B. Fliermans.
Geomicrobiology Journal GEJODG, Vol. 6, No. 3/4, p 157-170, 1988. 4 fig, 4 tab, 34 ref. DOE Contract DE-AC09-76SR00001.

Descriptors: *Groundwater pollution, *Chlorinated hydrocarbons, *Microbial degradation, *Sediments, *Biodegradation, *Fate of pollutants, Trichloroethylene, Lipids, Fatty acids, DNA, Tritium, Carbon radioisotopes.

Soil microcosms and enrichment cultures from subsurface sediments and goundwaters contaminated with trichloroethylene (TCE) were examined. Total lipids, (1-C14)acetate incorporation into lipids, and (Me-H3)thymidine incorporation into DNA were determined in these subsurface environments. In heavily TCE-contaminated zones (>500 mg/L) radioisotopes were not incorporated into lipids or DNA. Radioisotope incorporation occurred in sediments both above and below the TCE plume. Phospholipid fatty acids (PLFA) were not detected, i.e., <0.5 pmol/L in heavily contaminated groundwater samples. In less contaminated waters, extracted PLFA concentrations were greater than 100 pmol/L and microbial isolates were readily obtained. Degradation of 30-100 mg/L TCE was observed when sediments were amended with a variety of energy sources. Microorganisms in these subsurface sediments have adapted to degrade TCE at concentrations greater than 50 mg/L. (Author's abstract)
W89-13030

SILVER CONTAMINATION IN THE MARINE POLYCHAETE ANNELID SABELLA PAVONINA S.: A CYTOLOGICAL AND ANALYTIC STUDY.
Paris-6 Univ. (France). Lab. d'Histologie et de Cytologie des Invertebres Marins.
N. Koechlin, and M. Grasset.
Marine Environmental Research MERSDW, Vol. 26, No. 4, p 249-263, 1988. 4 fig, 2 tab, 32 ref.

Descriptors: *Polychaetes, *Silver, *Bioaccumulation, *Path of pollutants, Sulfur, Sabella.

The marine annelid Sabella pavonina accumulates silver up to 22.05 + or - 7.10 mg/kg dry weight when immersed for 2 months in sea water with 50 microgram/l silver. The connective tissue of the nephridia and of the gut are the main accumulation sites of the metal. Silver, together with sulfur, are located in star-shaped granules having a mean diameter of 0.18 + or - 0.03 microns. Simultaneously to the silver accumulation in the connective tissue, an excretory process assumes the transcellular transit of silver granules via the lysosomes and the metal is released in the urinary fluid within discarded cell fragments. Eight weeks after the end of the silver accumulation experiments, newly synthesized connective tissue, devoid of silver granules, underlies the nephridia and the gut epithelium. The few remaining star granules in the nephridia are pushed towards the middle of the connective tissue and their silver concentration decreases from 2182 + or - 760 mmol/kg to 280 + or - 50 mmol/kg. A similar decrease of sulfur occurs. The contamination process is thus reversible. (Author's abstract)
W89-13040

CADMIUM IN MYTILUS SPP.: WORLDWIDE SURVEY AND RELATIONSHIP BETWEEN SEAWATER AND MUSSEL CONTENT.
Institut Francais de Recherche pour l'Exploitation de la Mer, Nantes.
D. Cossa.
Marine Environmental Research MERSDW, Vol. 26, No. 4, p 265-284, 1988. 10 fig, 2 tab, 65 ref.

Descriptors: *Reviews, *Bioaccumulation, *Path of pollutants, *Mussels, *Mytilus, *Cadmium, *Water quality standards, *Aquaculture, Gironde Estuary, France, Tissue analysis, Crustaceans.

A worldwide literature survey of data on Cd concentration in the soft tissue of the mussel, Mytilus, from 591 stations is presented. These stations are from 13 regions. Geometric means for the regions vary from 0.6 to 3.3 microgram/g (dry weight) for the Barents Sea and the Northeastern Pacific coast, respectively. The averages of 7 of these regions, for which reliable Cd concentrations in seawater were available, were used to calculate a relationship between Cd concentrations in seawater and mussel soft tissue. The relationship was highly significant: (Cd) mussel (microgram/g, dry weight) = 0.074 (Cd) water (ng/L) + 0.39 ($P < or = 0.0005$). This model was successfully applied in the context of the contamination of the Gironde estuary (France). It can also be used to define a water quality criterion for mussel breeding areas (150ng/L for Cd) consistent with the quality criterion defined for shellfish for human consumption. (Author's abstract)
W89-13041

CONTROLLING SEEPAGE FROM EVAPORATION PONDS.
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 5G.
W89-13044

TWO DIMENSIONAL NUMERICAL MODELING OF HYDRODYNAMICS AND POLLUTANT TRANSPORT IN A WET DETENTION POND.
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-13050

HYDRAULIC PERFORMANCE AND CONTROL OF POLLUTANTS DISCHARGED FROM A COMBINED SEWER STORAGE OVERFLOW.
Manchester Univ. (England). Dept. of Civil Engineering.
A. J. Saul, and R. C. Thornton.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 747-756, 1989. 4 fig, 3 tab, 13 ref.

Descriptors: *Water pollution control, *Sewer systems, *Sanitary engineering, *Hydraulics, *Combined sewer overflows, *Model studies, Waste disposal, Wastewater, Overflow, Discharge measurements.

The development of the Wallingford Procedure (WASSP) and the MOSQITO models will provide the sewerage engineer with design tools to assess the quantitative and qualitative performance of sewer systems. As part of the development of such a quality model, a fieldwork program of research to monitor the hydraulic performance and the temporal variation of pollutants in the inflow and the overflow at five combined sewage overflows in the North West of England has been undertaken. The instrumentation used at a typical field site is described and the monitored temporal variation of pollutants is illustrated for a number of storm events. The results show the complexity of the monitored pollutographs and highlight the large number of variables which influence combined sewer quality. Using data monitored in 1986, it is hypothesized that the long term impact of combined sewer discharges on receiving waters may be estimated from the flow retention performance and some estimate of annual average pollutant concentration. To predict the short term impact on river quality, it is necessary to consider the complex processes associated with combined sewer flow and to include the separation performance of the overflow structure. (Author's abstract)
W89-13052

EXPERIMENTAL AND THEORETICAL STUDIES OF SULFIDE GENERATION IN SEWERAGE SYSTEMS.
Monash Univ., Clayton (Australia). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W89-13053

CHEMICAL CONTROLS ON THE FATE OF MERCURY AND LEAD CODISPOSED WITH MUNICIPAL SOLID WASTE.
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5E.
W89-13060

EXPERIMENTAL STUDIES ON BIOLOGICAL AND CHEMICAL OXIDATION OF DISPERSED OIL IN SEAWATER.
Kuwait Inst. for Scientific Research, Safat. Dept. of Environmental Sciences.
P. Literathy, S. Haider, O. Samhan, and G. Morel.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 845-856, 1989. 4 fig, 4 tab, 19 ref.

Descriptors: *Oil pollution, *Fate of pollutants, *Biodegradation, *Oxidation, *Biological oxidation, *Seawater, *Oily water, Weathering, Synergistic effects, Gas chromatography, Spectrophotometry.

With an understanding of the different physical, chemical and biological weathering processes, a series of laboratory experiments were conducted to describe biological and chemical oxidation processes at realistically low concentrations of physically and chemically dispersed oil in seawater by incubating living and sterilized samples spiked with oil alone, oil-dispersant mixture and dispersant alone, under light and dark conditions. Biological oxygen and photosynthetic oxygen production were characterized by the variation in total extractable matter and surfactant concentration, respectively. Gas chromatography, infrared and fluorescence spectrophotometry were used for the characterization of the petroleum and its degradation compounds. Biological oxidation was considered the major process in the living seawater sample incubated in the dark, and chemical oxidation (photo-oxidation) in the sterilized seawater sample exposed to light. In the early stages of each experiment, biodegradation of the physically dispersed oil progressed faster that the chemically dispersed one due to the concurrent degradation of the dispersant and the limited assimilative capacity of the seawater. The n-alkanes, mono-and dicyclic aromatic compounds showed significant biodegradation and limited photo-oxidation in the chemically dispersed oil. Synergistic degradation was observed when biological and chemical oxidation progressed simultaneously. (Author's abstract)
W89-13061

DEGRADATION OF POLYELECTROLYTES IN THE ENVIRONMENT: INSIGHTS PROVIDED BY SIZE EXCLUSION CHROMATOGRAPHY MEASUREMENTS.
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-13062

DETERMINATION OF BIODEGRADATION KINETICS THROUGH USE OF ELECTROLYTIC RESPIROMETRY.
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
C. P. L. Grady, J. S. Dang, D. M. Harvey, A. Jobbagy, and X. L. Wang.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 957-968, 1989. 4 fig, 3 tab, 25 ref.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Culturing techniques, *Kinetics, *Electrolysis, *Biodegradation, *Respirometry, Batch reactors, Organic compounds, Growth.

It is proven that it is possible to determine the kinetics of biodegradation of single organic compounds by using only measurements of oxygen consumption in batch reactors. Batch experiments were conducted using acclimated biomass growing on aniline or benzoic acid in which simultaneous determinations over time were made of oxygen consumption, substrate removal (by SCOD, DOC and 14C) and cell growth. Kinetic parameters were estimated by applying nonlinear curve-fitting techniques to each of the data sets. There were no important differences between the parameter estimates determined from oxygen consumption data and any of the measurements of substrate removal. In general, parameter estimates made with cell growth data were the least reliable. (Author's abstract)
W89-13072

DILUTION AND TRANSPORT PREDICTIONS FOR OCEAN OUTFALLS.
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
P. J. W. Roberts.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 969-979, 1989. 7 fig, 1 tab, 9 ref.

Descriptors: *Wastewater outfall, *Path of pollutants, *Wastewater disposal, *Ocean dumping, *Ocean bottom, *Shores, Flow, Dilution, Transport.

Dilution and transport predictions for an ocean outfall proposed for the Barra da Tijuca, Rio de Janeiro are summarized. The initial characteristics of the wastefield are predicted using the results of recent experiments on submerged wastefield characteristics in stratified flows. Using measured currents and stratifications, it can be predicted that the proposed design will result in a wastefield which is always submerged, whose thickness varies from 8.5 to 23.1 m and whose dilution varies from about 200 to well over 2000. The wastefield will often stay near the ocean bottom. Far field transport due to currents is calculated and expressed in terms of spatial visitation frequency, the probability of the wastefield visiting any location. It is shown that no effluent reaches shore with a travel time less than 5.5 hours, and computations including oceanic diffusion and bacterial mortality suggest maximum shoreline coliform concentrations of 500 per 100 ml; 98% of the time, they will be less than this. These estimates of shoreline bacteria are conservatively high, and much lower than computed by methods assuming steady onshore currents. (Author's abstract)
W89-13073

UNIFIED METHOD OF ESTIMATING LONGITUDINAL DISPERSION IN ESTUARIES.
California Univ., Richmond. Sanitary Engineering and Environmental Health Research Lab.
J. K. Park, and A. James.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 981-993, 1989. 8 fig, 4 tab, 33 ref.

Descriptors: *Diffusion coefficient, *Advection, *Path of pollutants, *Estuaries, *Model studies, *Salinity, *Water quality, Estimating.

A procedure was developed to estimate the rate of longitudinal dispersion from the observed data and verified by applying it to both the narrow, partially-stratified estuary and the wide, well-mixed estuary. It was found that the dispersive flux is not proportional to the longitudinal salinity gradient (ds/dx) in estuaries and is most closely related to velocity, the advective flux and (ds/dx) squared rather than ds/dx. The results obtained from the procedure showed that negative longitudinal dispersion can occur especially in flood tide. It was investigated whether the dispersion coefficient estimated from observed salinity data can be applied to the prediction of a water quality, such as dissolved oxygen, biochemical oxygen demand, ammonia, or temperature. The observed dispersion coefficients were successfully applied in a water quality model. (Author's abstract)
W89-13074

NUMERICAL SIMULATION MODEL FOR PREDICTION OF BOD REMOVAL RATE IN STREAMS.
Tokyo Univ. (Japan). Inst. of Industrial Science.
H. Kawashima, and M. Suzuki.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 1003-1014, 1989. 6 fig, 2 tab, 6 ref.

Descriptors: *Stream pollution, *Fate of pollutants, *Streams, *Model studies, *Simulation, *Biochemical oxygen demand, *Dissolved oxygen, Kinetics, Mass transfer, Numerical analysis, Prediction, Oxygen requirements, Energy dissipation, Mass transfer.

A numerical simulation model is developed in order to predict biochemical oxygen demand (BOD) removal rate in streams on the basis of mass transfer and biochemical reaction kinetics. The double layer of a flat aerobic and anaerobic bacterial film applies to BOD and dissolved oxygen (DO) balances in a stream. A relationship which relates energy dissipation, BOD and DO concentrations in streams and surface area available for attached biomass to the BOD removal rate per unit area is proposed. The different oxygen consumption rates observed in actual streams can be explained by using the proposed model. The oxygen consumption rates in natural streams can be interpreted by a model based on the relation between energy consumption rate, BOD concentration in flow, and solid surface area per unit water surface. The BOD removal rate per unit area is less affected by the difference of energy dissipation rate, but more dependent on surface area ratio. By avoiding use of the empirical parameters such as oxygen consumption rate constant, it is possible to estimate the profiles of BOD and DO concentrations. (Miller-PTT)
W89-13076

RIVER QUALITY MODELS FOR CONSENT SETTING IN ENGLAND AND WALES.
WRC Engineering, Swindon (England).
C. P. Crockett, R. W. Crabtree, and I. D. Cluckie.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 1015-1024, 1989. 4 fig, 3 tab, 23 ref.

Descriptors: *Water pollution control, *England, *Wales, *Water quality standards, *Water quality, *Waste disposal, *Effluents, *Model studies, Rivers, Wastewater treatment, Comparison studies, Utilities, Catchment areas, Administrative agencies, Stochastic models, Future planning, Long-term planning, Effluent limitations, Statistical analysis, River systems, Hydrologic data collections, Policy making.

In England and Wales, the placing of effluent discharge consents within a statistical framework has led to the development of a new hybrid type of river quality model. Such catchment scale consent models (CSCMs) have a stochastic component for the generation of model inputs and a deterministic component to route them through the river system. The existing approaches for consent modeling used by various Water Authorities are reviewed and compared. A number of possible future developments are suggested including the potential need for a national approach to the review and setting of long-term consents. Three Water Authorities have developed CSCMs for reviewing long-term consents. These models are TOMCAT (developed by Thames Water), SIMCAT (developed by Anglian Water) and STREAMS (developed by Severn Trent Water). The three models have placed different emphasis on the various components. SIMCAT concentrates on providing a method to produce a catchment review and upgrading proposals within a short time scale. STREAMS emphasizes the need to obtain the most information from the limited database normally available. TOMCAT attempts to model the various processes affecting the observed river quality and to provide a well-structured framework for model development. Overall, no one model can be considered to be superior. In selecting any of them, the user needs to have a clear understanding of their requirements. Crucial to this decision will be the availability of the time scale within which results have to be obtained and the required level of accuracy associated with the simulation results. (Miller-PTT)
W89-13077

APPLICATION OF EXPERT SYSTEMS TECHNOLOGY IN WATER QUALITY MODELING.
Environmental Protection Agency, Athens, GA.
For primary bibliographic entry see Field 7C.
W89-13080

GROUNDWATER CONTAMINATION WITH ARSENIC AND OTHER TRACE ELEMENTS IN AN AREA OF THE PAMPA, PROVINCE OF CORDOBA, ARGENTINA.
Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina). Dept. de Geoquimica y de Aplicaciones Geologicas de la Teleobservacion.
H. B. Nicolli, J. M. Suriano, M. A. Gomez Peral,

L. H. Ferpozzi, and O. A. Baleani.
Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 1, p 3-16, July-August 1989. 6 fig, 9 tab, 30 ref.

Descriptors: *Geochemistry, *Water pollution sources, *Water quality, *Argentina, *Groundwater pollution, *Trace elements, *Arsenic, Pampas, Fluorine, Vanadium, Uranium, Molybdenum, Geohydrology, Satellite technology, Remote sensing, Salinity, Loess, Volcanic glass, Groundwater movement, Mineralogy.

A geochemical study of the groundwater of the pampa in the province of Cordoba, Argentina, is reported. Physical-chemical parameters, dissolved solids, and seven trace elements were determined in 60 selected water samples. Systematic and accurate measurements of arsenic, fluorine, and vanadium were performed for the first time. The geographic distribution of the seven trace elements was mapped and its correlation with the anioncation composition of the water was studied. Eighty-four percent of the water analyzed showed arsenic contents over 0.05 mg/l. The maxima for arsenic, fluorine, vanadium, and uranium contents were found in the western part of the study area, in waters containing dominated by alkali metal cations. Maximum selenium and antimony contents were found in the eastern part of the areas, whereas molybdenum distribution showed no relationship to the other groups. The geographic distribution of trace elements seemed to be related to the subsurface structure as inferred from interactive digital analysis of Landsat imagery. The movements of the subsoil have disturbed surface and subsurface drainage, thus influencing the water salinity and trace element contents. To investigate the origin of contamination, 54 loess samples were collected at wells in depths ranging from the surface down to the water table. This loess, which has a high proportion of volcanic components, mainly rhyolitic glass, exhibits a chemical composition corresponding to that of a dacite. The loess and volcanic glass show anomalous contents of all contaminant trace elements, mainly arsenic and selenium. For this reason, loess is considered to be the most important source of contamination of this groundwater area. (Author's abstract)
W89-13111

CASE STUDIES IN ORGANIC CONTAMINANT HYDROGEOLOGY.
Waste Management, Inc., Oak Brook, IL. Environmental Management Dept.
J. A. Baker.
Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 1, p 17-33, July-August 1989. 15 fig, 2 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Groundwater pollution, *Geohydrology, *Organic wastes, Landfills, Hazardous materials, Radioactive wastes, Path of pollutants, Geologic formations, On-site investigations, Priority pollutants, Case studies, Wells, Volatile organic compounds.

The effective management of domestic solid waste and hazardous, toxic, and radioactive waste is a major problem in the area of environmental geology and water sciences throughout the world. A series of case studies is presented of organic contaminants from both solid and hazardous waste disposal facilities to provide examples of these problems. The facilities were investigated to determine risks and liabilities before acquisition, to determine the site hydrogeologic conditions for design of appropriate groundwater monitoring plans, and/or to determine the potential for groundwater contamination. The case studies are of disposal facilities located in glacial tills, carbonaceous weathered clay soils, weathered shale, limestone bedrock, dolomite bedrock, and alluvial and sedimentary deposits. The results of these studies and investigations show certain relationships in the distribution of organic pollutants to the different geologic and hydrogeologic characteristics of each facility. In each of the four case studies, all 129 priority pollutants were analyzed in private wells and/or monitoring wells. The 31 volatile organic compounds (VOCs) of the priority pollutant list were the majority of organic compounds detected. When VOCs are found in groundwater impacted by disposal facilities, they are present in groups and tend to be distributed in patterns based on their relative concentrations. It is rare to find only one or two VOCs from facilities where leakage has been detected. The ethylenes and ethanes appear to be more prevalent and mobile than aromatic VOCs. The aromatics are restricted primarily to leachates and wastes and in monitoring wells located adjacent to facilities. (Rochester-PTT)
W89-13112

GEOCHEMISTRY OF SEDIMENTS IN THE BACK BAY AND YELLOWKNIFE BAY OF THE GREAT SLAVE LAKE.
National Water Research Inst., Burlington (Ontario).
A. Mudroch, S. R. Joshi, D. Sutherland, P. Mudroch, and K. M. Dickson.
Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 1, p 35-42, July-August 1989. 6 fig, 3 tab, 16 ref.

Descriptors: *Water pollution sources, *Canada, *Mine wastes, *Heavy metals, *Arsenic, *Zinc, *Lake sediments, Great Slave Lake, Cores, Paleolimnology, Dating, History, Radioactive dating, Cesium radioisotopes, Lead radioisotopes.

Gold mining activities have generated wastes with high concentrations of arsenic and zinc in the vicinity of Yellowknife, Northwest Territories, Canada. Some of the waste material has been discharged into Yellowknife Bay of Great Slave Lake. Concentrations of arsenic and zinc were determined in sediment cores collected at the depositional areas of Yellowknife Bay. Sedimentation rates were estimated using two different radiometric approaches: the depth profiles of cesium 137 and lead 210. Geochemical analysis of the sediment cores indicated input of similar material into sampling areas over the past 50 yr. Age profiles of the sediment constructed from the radionuclide measurements were used to determine historical trends of arsenic and zinc inputs into Yellowknife Bay. The historical record was in good agreement with implemented remedial actions and the usage patterns of both elements. (Author's abstract)
W89-13113

HEAVY METAL CONTAMINATION OF A GREENLAND FJORD SYSTEM BY MINE WASTES.
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans.
D. H. Loring, and G. Asmund.
Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 1, p 61-71, July-August 1989. 4 fig, 5 tab, 20 ref.

Descriptors: *Water pollution sources, *Greenland, *Mine wastes, *Heavy metals, *Path of pollutants, Lead, Zinc, Cadmium, Particulate matter, Fjords, Chemical reactions, Mussels, Algae, Sediments, Tissue analysis, Shellfish.

Since 1973, about 500,000 tons/yr of metal-rich particulate tailings from a lead/zinc flotation mill have been discharged through a submarine outfall into a two-fjord system on the west coast of Greenland. Differential solubilization of particulate metals by seawater, seasonal water mixing, and sill exchange tailings dispersal processes have resulted in high, but seasonally variable, Zn, Cd, and Pb contamination of the water and suspended particulate matter (SPM). Chemical partition of the SPM shows that most (85-99%) of the Pb, but relatively low proportions of Zn (14-26%) and Cd (10-20%) are weakly bound to the SPM. Such particulate metal characteristics allow the real time effects of tailings discharges and dispersal on the system to be traced even in the sediments where tailings accumulation is very slow (< 0.1 cm/yr). Fjord seaweeds and blue mussels also contain varying amounts of Zn, Pb, and Cd, depending on the metal and their location relative to the tailings outfall. They apparently responded almost instantly to the metal contamination, as did the water and SPM. High Pb concentrations in the fjord mussels most likely derive from the preferential uptake of available particulate Pb, whereas the seaweeds appear to derive most of their heavy metal concentrations from the dissolved phase. The evidence from this and other sites, and from experimental work, indicates that any discharge of Pb-particles into the marine environment, either directly as mine wastes or indirectly from natural runoff from current and former lead mining sites, results in immediate lead contamination of the in situ mussel population. (Author's abstract)
W89-13115

SULFATE PRODUCTION AND DEPOSITION IN MIDLATITUDE CONTINENTAL CUMULUS CLOUDS: PART I. CLOUD MODEL FORMULATION AND BASE RUN ANALYSIS.
Washington Univ., Seattle. Geophysics Program.
G. R. Taylor.
Journal of the Atmospheric Sciences JAHSAK, Vol. 46, No. 13, p 1971-1990, July 1, 1989. 12 fig, 8 tab, 54 ref. Acid Deposition Modelling Project Contracts NCAR-S5012 and SUNY 320-6476-A.

Descriptors: *Water chemistry, *Acid rain, *Cloud physics, *Water pollution sources, *Path of pollutants, Sulfates, Performance evaluation, Ice, Entrainment, Numerical models, Mathematical models, Cloud models, Algorithms, Montana, Sensitivity analysis, Precipitation.

A 1.5-dimensional Eulerian cumulus cloud model was developed that incorporates the following elements: (1) two in-cloud regions, (2) a bulk water parameterization, including the ice phase; (3) an entrainment formulation based on the turbulent kinetic energy; (4) a sustained subcloud forcing; and (5) a flux-corrected transport algorithm in the numerical advection scheme. This model formulation was chosen to provide a simple dynamic framework that permits simultaneous up-downdrafts in-cloud. The model is compared against aircraft and radar data for clouds observed during the Cooperative Convective Precipitation Experiment held in south-central Montana during the summer of 1981. The overall dynamic, thermodynamic, and microphysical agreement is good. Sensitivity analysis of adjustable parameters indicates that model response is not overly sensitive to the characteristic entrainment mixing length used, but fairly sensitive to parameters used in the ice phase microphysics. (See also W89-13118) (Author's abstract)
W89-13117

SULFATE PRODUCTION AND DEPOSITION IN MIDLATITUDE CONTINENTAL CUMULUS CLOUDS: PART II. CHEMISTRY MODEL FORMULATION AND SENSITIVITY ANALYSIS.
Washington Univ., Seattle. Geophysics Program.
G. R. Taylor.
Journal of the Atmospheric Sciences JAHSAK, Vol. 46, No. 13, p 1991-2007, July 1, 1989. 9 fig, 13 tab, 31 ref. Acid Deposition Modelling Project Contracts NCAR-S5012 and SUNY 320-6476-A.

Descriptors: *Water chemistry, *Acid rain, *Cloud physics, *Water pollution sources, *Path of pollutants, Sulfates, Ozone, Chemical reactions, Ice, Oxidation, Numerical models, Mathematical models, Cloud models, Performance evaluation, Prediction.

A 1.5-dimensional Eulerian cumulus cloud model was employed to examine characteristics of in-cloud sulfate chemistry. Specifically, a study is presented of the following: (1) the relative importance of aerosol scavenging to in-cloud production of sulfate through oxidation of sulfur dioxide by ozone and hydrogen peroxide; (2) the importance of the entrainment of environmental air in the formation and subsequent deposition of sulfate; (3) the role of ice phase microphysical processes in determining the chemical properties of precipitation; and (4) the chemical effects on clouds due to a modification of the environment by previous clouds. The results for a continental background or moderately polluted atmosphere indicate that aerosol scavenging accounts for between 50% and 80% of the in-cloud sulfate ultimately deposited; that

ozone oxidation of sulfur dioxide may be important in the upper regions of the cloud; that, although entrainment of environmental air is important in the cloud dynamics and microphysics, it is relatively unimportant in the chemistry; and that neglect of the ice phase when considering chemistry in these clouds may lead to overestimates of about 200% in sulfate deposition. (See also W89-13117) (Author's abstract)
W89-13118

PHYSICO-CHEMICAL INTERACTIONS AND BIOCONCENTRATION OF ZINC AND LEAD IN THE INDUSTRIALLY POLLUTED HUSAINSAGAR LAKE, HYDERABAD, INDIA.
Osmania Univ., Hyderabad (India). Dept. of Microbiology.
A. K. Prahalad, and G. Seenayya.
Environmental Pollution ENPOEK, Vol. 58, No. 2/3, p 139-154, 1989. 1 fig, 4 tab, 35 ref. University Grants Commission, New Delhi, India No. 1432/82 (SR-II).

Descriptors: *Industrial wastes, *India, *Heavy metals, *Path of pollutants, *Lake sediments, *Water pollution, *Biological magnification, *Zinc, *Lead, Plankton, Phytoplankton, Zooplankton, Fish, Physicochemical properties, Food chains, Sediment transport, Vertical distribution, Sediment distribution, Stratification, Trophic level, Mercury, Chlorinated hydrocarbons.

Heavy metals are toxic pollutants and their presence in the environment, especially in water, is a current major concern. In water (the primary contaminated medium) introduced heavy metals are exposed to many different chemical changes, whereby a high degree of variation in metal concentration arises. Thus, analysis of this medium alone supplies only a very transitory view of the metal load. Metals that do not remain soluble in water sink and absorb into bottom sediments. Knowledge of the concentration and distribution of heavy metals in profiles of lake water and surficial sediments are important to our understanding of the transport processes and fate of heavy metals in water systems. The interactions of different physicochemical parameters in the water profile, and the bioconcentrations of zinc and lead in Husainsagar Lake, India, were studied. The concentrations of both metals were found to be within permissible limits. The concentration of zinc and lead in the vertical profile were highest in the bottom stratum of the lake and least in the surface stratum. Their concentrations were two to three thousand-fold more in surficial sediments than in the overlying water column. The concentration of zinc increased with increasing trophic level from nanoplankton to zooplankton, but not to fish, and the concentration of lead decreased with increasing trophic level from nanoplankton to phytoplankton to zooplankton to fish, illustrating no bioconcentration of metals in the classic sense of the term as has been noted for mercury and chlorinated hydrocarbons. (Author's abstract)
W89-13154

CAESIUM-137 IN PERCH IN SWEDISH LAKES AFTER CHERNOBYL--PRESENT SITUATION, RELATIONSHIPS AND TRENDS.
Uppsala Univ. (Sweden). Dept. of Hydrology.
L. Hakanson, T. Andersson, and A. Nilsson.
Environmental Pollution ENPOEK, Vol. 58, No. 2/3, p 195-212, 1989. 9 fig, 6 tab, 14 ref.

Descriptors: *Cesium radioisotopes, *Chernobyl, *Path of pollutants, *Perch, *Sweden, *Lakes, *Fate of pollutants, *Radioactivity effects, *Nuclear reactors, *Acid rain, Environmental effects, Lake restoration, Cesium, Acidic water, Environmental impact statement, Fallout, Lake morphometry, Limnology, Drainage areas, Sediment sampler, Lake sediments, Sediment transport, Radioactive wastes, Hardness, Phosphorus.

The Chernobyl nuclear accident and general acidification of Swedish water systems are the base for determination of the linkage(s) between the concentration of Cesium-137 (Cs-137) in fish, the lake load of Cs, and lake characteristics, to give a preliminary prognosis on the environmental recovery, and to put the results within a wider framework of environmental hazard analysis. A broad set of data on limnology, morphometry, and drainage area conditions were collected from 41 lakes during 1986 and 1987. Cs-137 concentrations were determined in one-year-old perch, water, material collected from sediment traps, and from surficial sediments. It was found that the average value for Cs-137 in the perch has dropped for all lakes from 9800 Becquerels per kilogram (Bq/kg) to 5040 Bq/kg between the two years. Generally the decrease is 5-90%. No factors could be specifically linked to this decrease. The concentrations of Cs in sediment traps have decreased an average of 80%. Very high correlations were found between the concentrations of Cs-137 in perch and in the traps. Between 1-10% (mean 3-9%) of the initial fallout deposition to the drainage area was transported from land to water from June to August 1986. The variation in initial fallout deposition explains 65-69% of the variability in the Cs-137 in the fish; the degree of explanation increases to 85% if one takes into account the lake water hardness and total phosphorus. Between 4000 and 7000 lakes in Sweden appear to have concentrations of Cs-137 in perch higher than 1500 Bq/kg (the present allowance), figures which emphasize the seriousness of the impact of the Chernobyl accident on the environmental conditions in Sweden. (Author's abstract)
W89-13155

APPLICATION OF BACTERIOPHAGE AS TRACERS OF CHALK AQUIFER SYSTEMS.
Surrey Univ., Guildford (England). Dept. of Microbiology.
For primary bibliographic entry see Field 2F.
W89-13158

EFFECTS OF NUTRIENTS ON THE SURVIVAL OF ESCHERICHIA COLI IN LAKE WATER.
Warwick Univ., Coventry (England). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W89-13159

AUTOMATED CALIBRATION OF A CONTAMINANT TRANSPORT MODEL FOR A SHALLOW SAND AQUIFER.
Interstate Commission on the Potomac River Basin, Rockville, MD.
K. J. Holmes, W.-S. Chu, and D. R. Erickson.
Ground Water GRWAAP, Vol. 27, No. 4, p 501-508, July-August, 1989. 7 fig, 2 tab, 13 ref. USGS Grant No. G1259-05.

Descriptors: *Solute transport, *Sand aquifers, *Path of pollutants, *Hydrologic models, *Transmissivity, *Model studies, *Calibrations.

An automated calibration technique for the United States Geological Survey Method of Characteristics (USGS-MOC) code was applied to a shallow sand aquifer where contamination due to leakage from a solvent recycling plant was detected. Using available water-table observations, transmissivity parameters for the USGS-MOC model were calibrated by an automated parameter identification (PI) techniques. Dispersivity was determined from trial-and-error simulations. For comparison purposes, the transmissivity parameters were also independently calibrated by trial-and-error simulations. The study results show that, although the PI-calibrated model can produce water-table contours that are in good agreement with the observations and the contaminant plumes produced by the USGS-MOC using parameters determined from the PI technique and the trial-and-error approach are not vastly different, the parameters determined by this technique are not considered to be physically plausible in all cases. The best strategy in model calibration would be to use both methods conjunctively. (Author's abstract)
W89-13164

THREE-DIMENSIONAL MIXING CELL SOLUTE TRANSPORT MODEL AND ITS APPLICATION.
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 2F.
W89-13165

WASTE STABILIZATION IN MULTILAYER AQUIFERS BY OPTIMAL HYDRAULIC CONTROL.
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-13166

ELECTRICAL RESISTIVITY OF THE VADOSE ZONE--FIELD SURVEY.
Rhode Island Univ., Kingston. Dept. of Geology.
For primary bibliographic entry see Field 7B.
W89-13167

APPROACH TO THE FIELD STUDY OF HYDRAULIC GRADIENTS IN VARIABLE-SALINITY GROUND WATER.
Geological Survey, Tampa, FL.
For primary bibliographic entry see Field 2F.
W89-13168

GROUND-WATER QUALITY VARIATIONS IN A SILTY ALLUVIAL SOIL AQUIFER, OKLAHOMA.
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W89-13169

NATURAL WATERS.
University Coll., London (England).
For primary bibliographic entry see Field 2K.
W89-13211

WATER QUALITY CLASSIFICATION.
Cranfield Inst. of Tech. (England).
For primary bibliographic entry see Field 5A.
W89-13212

COORDINATING THE WATER QUALITY ACT OF 1987.
Army Engineer District, Nashville, TN.
For primary bibliographic entry see Field 6E.
W89-13239

SEDIMENT-WATER INTERACTIONS AND CONTAMINANT PROCESSES.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. Gunnison, and J. M. Brannon.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 216-222, 1 tab, 5 ref.

Descriptors: *Fate of pollutants, *Reservoirs, *Sediment-water interfaces, *Water pollution sources, *Sediment contamination, Adsorption, Alkalinity, Hydrogen ion concentration, Iron, Aluminum, Manganese, Water quality, Microbial degradation.

Contaminants cause operations and maintenance problems for Corps of Engineers (CE) water resources projects in several ways. These include curtailment of project benefits, impairment of project purposes, and conflicts with state or Federal water quality standards. Interactions between contaminants and other components of the aquatic environment, such as suspended and bottom sediments, within the context of project operation are unknown. The term 'contaminant' is defined as any chemical or microbiological substance which, when present in excessive levels, interferes with the use of a project. Many problems with contaminants in reservoirs are a consequence of the interactions between contaminants and sediment. Many contaminants have a high affinity for sediments and are rapidly sorbed to them. A number of sediment-water interactions exert important influences on contaminants. Factors controlling these

interactions include sediment composition and concentration, adsorption/desorption processes, and microbial transformation kinetics. Sediment properties having a dominant influence on sediment-water interactions include oxidation-reduction potential, pH, alkalinity, organic carbon, iron, aluminum and manganese oxides, and sediment surface area. The nature and concentration of the contaminant itself are also important, particularly with regard to the affinity of the contaminant for sediment, water, or aquatic biota, and the behavior of the contaminant under varying environmental conditions. Work was undertaken to develop methods to quantify contaminant problems. This information will also be used as input in the development of project management and control strategies for contaminants at CE reservoir projects. To achieve this objective, existing information on abiotic and microbiological processes relating to contaminant interactions with sediment and water will be examined. From this information, which will eventually include state-of-the-art descriptive models and contaminant management and control strategies, methods for determining the impacts of sediment-water interactions on reservoir water quality and contaminant fate will be selected and developed. (See also W89-13231) (Lantz-PTT)
W89-13253

CONTAMINANT MODELING FOR CORPS ACTIVITIES.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
S. L. Bird.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 223-227, 8 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Model studies, *Computer models, Computer programs, Water quality control.

A variety of chemical fate models may be useful to managers when the presence of toxic substances complicate project operations. Available computer models, processes incorporated in each, guidance for applying these models to Corps activities, and data requirements and complexity of these models are discussed. Two different categories of modeling are considered: (1) simplified screening techniques; and (2) high resolution models. Simplified screening techniques require little field data and could be applied with less than one man month worth of effort. Although these techniques offer limited resolution and typically supply an order of magnitude type analysis, their application can provide guidance in the identification of potential problems, sensitivity of the system to particular parameters, and direction for future data collection efforts. The high resolution models offer more detailed system resolution, require months to years of effort for application, and typically involve substantial field data collection for meaningful model implementation. (See also W89-13231) (Lantz-PTT)
W89-13254

ADVANCES IN LABORATORY TESTING TO QUANTITATIVELY DESCRIBE SEDIMENT-WATER INTERACTIONS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. M. Brannon, and T. E. Myers.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 228-241, 5 fig, 32 ref.

Descriptors: *Path of pollutants, *Spoil banks, *Testing procedures, *Dredging wastes, *Sediment water-interfaces, *Leaching, Chemical analysis, Adsorption, Batch tests.

To determine the impact that contaminants associated with sediment may have on the environment, laboratory testing of sediment is often conducted. Over the years these tests have taken many forms, such as the elutriate test, column tests, and bioassays. The elutriate test and many of the tests used today to test sediment and solid wastes are batch tests. Batch leaching tests in combination with column leaching tests are currently being investigated at the Waterways Experiment Station (WES) as a means of providing planning level assessments of leachate quality in confined disposal facilities containing contaminated dredged material. The theory of contaminant partitioning (to describe the adsorption of contaminants and other compounds of interest on soils, sediments, and other solid phases), the current state of development of batch test procedures used for obtaining distribution coefficients, and some uses for the distribution coefficients were examined. The extraction procedure (EP) and Toxicity Characteristic Leach Procedure (TCLP) are criteria-comparison type tests developed out of regulatory necessity for standardized procedure but they do not provide information on leaching kinetics or on equilibrium desorption coefficients for the solid and aqueous phases. The elutriate test, which is also fast and standardized, was designed to simulate a specific disposal situation for a specific type of dredged material. Elutriate data can be extrapolated to the field situation but because of the complexity of the sediment system, it is not likely that a single batch test could adequately simulate the process. Results from batch tests, column tests, and a permeant-porous media equation, are being used to test the hypothesis that contaminant interphase transfer can be described as equilibrium-controlled, linear desorption. (See also W89-13231) (Lantz-PTT)
W89-13255

APPROACH FOR ASSESSING IMPACTS OF IN-PLACE CONTAMINATED SEDIMENTS ON WATER QUALITY.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
T. L. Hart, D. Gunnison, and J. M. Brannon.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 242-250, 2 ref.

Descriptors: *Sediment contamination, *Water pollution sources, *Water quality, Environmental effects, Costs, Sediment characteristics, Hydrodynamics, Fate of pollutants, Cost-benefit analysis.

A concept that can be used by Corps of Engineers (CE) planners to identify and quantify environmental impacts from in-place contaminated sediments on a water body is considered. The basic idea is to allow the project planner the ability to identify and quantify environmental impacts from in-place sediments on the water quality of the water body, thereby allowing for an accurate evaluation of the project cost vs. benefits from removing the existing sediments. Various factors which will influence this assessment include: sediment characteristics, concentration and type of contaminants in the sediments, system hydrodynamics, contaminant sources, and existing and proposed uses of the water body. The concept can be applied through a three-phase approach which allows quantification of cost and benefits associated with in-place sediments and proposed actions. By using a three-phase approach that incorporates the maximum use of existing data during Phase I, cost for field data collection and analyses can be kept to a minimum. By using a phase approach decision points can be incorporated during each phase for assessing proposed benefits to be gained from collection and analysis of additional data which may be disproportionate to the incurred cost. In the Grand Calumet River/Indiana Harbor Canal (GCR/IHC) case study, the approach was limited to Phase I with limited data collection under Phase II. Based on the analyses of existing data, it was concluded that insufficient data exist to quantify benefits. A report was prepared that delineated the findings and made recommendations on additional studies. To provide for flexibility, recommendations for future studies were given at three study levels. This approach allows the Chicago District the option of tailoring studies to meet specific objectives for maximum benefit at lowest cost. (See also W89-13231) (Lantz-PTT)
W89-13256

EVALUATING BIOAVAILABILITY OF NEUTRAL ORGANIC CHEMICALS IN SEDIMENTS: A CONFINED DISPOSAL FACILITY CASE STUDY.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. U. Clarke, V. A. McFarland, and J. Dorkin.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 251-268, 8 fig, 3 tab, 10 ref.

Descriptors: *Path of pollutants, *Model studies,*Bioaccumulation, *Waste disposal, *Sediment contamination, Polychlorinated biphenyls, Biological studies, Tissue analysis, Fish, Invertebrates.

A simple model for bioaccumulation potential and bioavailability of neutral chemicals from sediments was applied in a Chicago Area confined disposal facility (CDF) case study. Tissue residues of total polychlorinated biphenyls (PCBs) in a number of fish and invertebrates within the CDF consistently reflected contamination of the sediments. Ratios of residues to sediment contamination were approximately constant regardless of species when concentration data were normalized on sediment organic carbon and on organism lipid. Steady-state conditions between sediment and organism contamination appear to exist within the CDF for all organisms analyzed, including those fish that normally are not thought to have direct contact with the sediments. Comparison of organism-residue:sediment-contamination relationships at sites outside the CDF indicated non-steady-state conditions where high sediment contamination existed. Higher tissue residues than are predicted by the model were found in biota taken from a site of low sediment contamination. This result is consistent with other recent laboratory and field results, but is not accounted for in the model. (See also W89-13231) (Lantz-PTT)
W89-13257

RECENT DEVELOPMENTS IN ESTIMATING POLYCHLORINATED BIPHENYL (PCB) LOSSES FROM CONFINED DISPOSAL FACILITIES.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. E. Myers, J. A. Miller, and F. L. Snitz.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 312-322, 9 ref.

Descriptors: *Spoil banks, *Polychlorinated biphenyls, *Waste disposal, *Path of pollutants, Leaching, Volatility, Permeability, Water quality, Case studies, Disposal sites, Dredging, Dikes, Seepage.

Estimates of polychlorinated biphenyl (PCB) losses from confined disposal facilities for dredged material indicate a trend for increased complexity in laboratory testing and computer modeling. Technical approaches to evaluation of confined disposal facilities (CDF) containment effectiveness are evolving toward increased sophistication as new issues about potential migration pathways are raised. The new issues relate to the adequacy of available predictive techniques for seepage losses, volatilization, transport through permeable dikes, ponded water quality during disposal, surface water quality impacts of near-shore and in-water confined disposal facilities with permeable dikes, and the technical basis for trade-off analysis. Recent developments in estimating PCB release from proposed and existing CDFs are discussed. Site-specific details are selectively introduced to illustrate important developments. Two completed studies (Indiana Harbor, IN and Everett Harbor, WA) and two ongoing studies (New Bedford Harbor, MA and Saginaw Confined Disposal Facility, MI) are discussed in terms of technical approaches, testing requirements, results, and problem areas. Since two of the studies have not been completed, discussion of results is limited. (See also W89-13231) (Lantz-PTT)
W89-13261

EROSION AND RESUSPENSION EFFECTS OF HURRICANE GLORIA AT LONG ISLAND SOUND DREDGED MATERIAL DISPOSAL SITES.

Corps of Engineers, Waltham, MA. New England Div.
T. J. Fredette, W. F. Bohlen, D. C. Rhoads, and R. W. Morton.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 323-334, 3 fig, 1 tab, 5 ref.

Descriptors: *Spoil banks, *Water pollution sources, *Hurricanes, *Dredging, *Waste disposal, *Suspended sediments, Sediment contamination, Erosion, Long Island, Disposal sites, Water currents, Storms, Bottom currents.

Dredged material disposal mounds at water depths of 20-30 m in Long Island Sound experienced relatively little erosion during the passage of Hurricane Gloria on September 27, 1985. Hurricane Gloria passed directly over the Central Long Island Sound disposal site with sustained winds of 130-140 km/hr. Bottom currents measured at a station at the New London disposal site, approximately 65 km east of the storm track, increased approximately 10 cm/sec over the ambient maximum of 35 cm/sec, and bottom wave pressures were significantly perturbed during the height of the storm. Near-bottom suspended sediment loads at the New London station were 2 mg/L before the storm and increased to 16 mg/L in response to the effects of wind-induced waves during the storm. Bathymetry and REMOTS sediment profiling camera surveys of the disposal mounds at Western and Central Long Island Sound disposal sites were conducted in late October 1985, and the results were compared to surveys from earlier in the year. In addition, the New London disposal site was surveyed in July 1986. At the Central Long Island Sound disposal site, only the mound designated CS-1 (with a silt cap) had a detectable volume change. The volume change observed at this mound may have occurred because of both erosion and consolidation. At the Western Long Island Sound and New London disposal sites, no difference in volume or minimum depth were observed at the sites' mounds. Results of this study provide increased confidence in the stability of dredged material disposal mounds at similar and greater depths and the caps used to isolate more contaminated material. (See also W89-13231) (Author's abstract)
W89-13262

SURFACE AND GROUNDWATER MONITORING AT TIMES BEACH CONFINED DISPOSAL FACILITY, BUFFALO, NEW YORK.
Corps of Engineers, Buffalo, NY. Water Quality Section.
R. P. Leonard.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 362-389, 5 fig, 17 tab, 1 ref.

Descriptors: *Water pollution prevention, *Monitoring, *Waste disposal, *Lake Erie, *Spoil banks, *Path of pollutants, *Times Beach, Disposal sites, Groundwater quality, Heavy metals, Leaching, Niagara River, Monitoring wells, Groundwater level, Aquifers.

The October 1984 report of the Niagara River Toxics Committee identified the Times Beach Confined Disposal Facility (CDF) as a possible source of contamination to the Niagara River. In addition, the Times Beach CDF was cited under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) for the possible release of hazardous substances. The 54-acre Times Beach CDF was used from the period of 1972 to 1976 for the confined disposal of polluted sediment dredged from Federal navigation channels in the Buffalo Harbor, the Buffalo River, and the Black Rock Channel. Although the Times Beach area is owned by the City of Buffalo, permission to install monitoring wells was granted to the Buffalo District by the City. The primary purpose of well installations was to determine the extent to which heavy metal and organic pollutants contained in the dredge material might be influencing groundwater quality. Groundwater levels in wells were also periodically monitored to determine any relationship between lake water levels and groundwater levels. The data suggests that significant heavy metals and organic contamination are associated with filterable and colloidal solids in groundwater or suspended sediment in the ponded areas of Times Beach. Filtered samples generally, but not always, showed lower levels of contaminants. Even filtered samples will have considerable colloidal particulates associated with them when it is considered that the filter size is 0.45 microns and colloidal particles range in size from approximately 1 micron to 0.0001 microns. The data indicates that groundwater below the dredge material is not being contaminated by leaching from the overlying dredge material even though it is a permeable sandy aquifer. Contaminants attached to the sediment do not solubilize significantly into the overlying pond water at the site. Suspended sediments in unfiltered samples may contain contaminants exceeding national standards. To the extent that sediments and suspended sediment are retained in the confined disposal facility, contaminants are greatly excluded from adjoining Lake Erie water. (See also W89-13231) (Lantz-PTT)
W89-13265

NORTH CAROLINA SANITARY LANDFILLS: LEACHATE GENERATION, MANAGEMENT, AND WATER QUALITY IMPACTS.
North Carolina State Univ., Raleigh. Dept. of Civil Engineering.
R. C. Borden, and T. M. Yanoschak.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-204432/AS. Price codes: A04 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Completion Report No. 243, (UNC-WRRI-89-243), March 1989. 53p, 4 fig, 10 tab, 50 ref, append. Project WRRI 70087.

Descriptors: *Leachates, *Solid waste disposal, *Monitoring, *Groundwater pollution, *North Carolina, Landfills, Water pollution sources, Organic wastes, Inorganic wastes, Heavy metals.

The most widely used method of solid waste disposal in North Carolina is burial in unlined municipally operated sanitary landfills (SLFs). A statistical analysis of existing surface-and groundwater monitoring data from 71 municipal sanitary landfills was performed to assess the impact of North Carolina SLFs on surface-and groundwater quality. A total of 322 surface and 411 groundwater quality records was analyzed using the SAS data system. Almost all the landfill records included inorganic and heavy metal analyses while approximately half of the records also include organic scans by GC/MS. Groundwater quality violations were detected for organic or inorganic pollutants at 53% of the landfills examined with adequate monitoring data. The severity of groundwater contamination at SLFs appears to be highly variable. At many of the landfills with groundwater quality problems, a 50% reduction in pollutant concentration would eliminate all violations. At a few isolated landfills, extremely high concentrations of organic and inorganic pollutants have been detected. At these landfills, greater than 99.99% reductions would be required to meet existing standards. These results suggest that: (1) most landfills do contaminate groundwater; (2) the severity of contamination is highly variable; and (3) the existing monitoring program is reasonably effective at detecting widespread trends. (Lambert-UNC-WRRI)
W89-13318

GEOHYDROLOGY AND SUSCEPTIBILITY OF MAJOR AQUIFERS TO SURFACE CONTAMINATION IN ALABAMA; AREA 4.
Geological Survey, Tuscaloosa, AL. Water Resources Div.
M. Planert, and J. Pritchett.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4133, 1989. 31p, 3 fig, 1 pl, 2 tab, 28 ref.

Descriptors: *Aquifers, *Carbonate rocks, *Groundwater movement, Potentiometric level, *Water pollution, *Geohydrology, *Alabama.

The U.S. Geological Survey, in cooperation with the Alabama Department of Environmental Management, is conducting a series of geohydrologic studies to delineate the major aquifers (those which provide water for public supplies) in Alabama, their recharge areas, and areas susceptible to contamination. This report summarizes these factors for two major aquifers in Area 4--Calhoun, Jefferson, St. Clair, Shelby, and Talladega Counties. The major aquifers in the study area are in Cambrian and Ordovician and Mississippian rocks. Highest yields from aquifers are associated with solution openings in carbonate rocks. Springs in the area provide substantial amounts of water for municipal supply. Coldwater Spring provides 17 million gal of water/day to the city of Anniston, the largest groundwater user in the area. All recharge areas for the aquifers are susceptible to contamination from land surface. Two conditions exist in the study area that may cause the aquifers to be highly susceptible to contamination on a local scale: fracturing of rock materials due to faulting and the production of a porous cherty soil through weathering. Where sinkholes are present, there may be a direct connection between the land surface and the aquifer. Areas with sinkholes are considered to be extremely susceptible to contamination. (USGS)
W89-13325

SOURCES AND CONCENTRATIONS OF DISSOLVED SOLIDS AND SELENIUM IN THE SAN JOAQUIN RIVER AND ITS TRIBUTARIES, CALIFORNIA, OCTOBER 1985 TO MARCH 1987.
Geological Survey, Sacramento, CA. Water Resources Div.
D. G. Clifton, and R. J. Gilliom.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $5.75, microfiche $4.00. USGS Water-Resources Investigations Report 88-4217, June 1989. 33p, 8 fig, 6 tab, 23 ref.

Descriptors: *Water pollution sources, *California, *San Joaquin River, *Kesterson Reservoir, *Selenium, *Trace elements, Rivers, Sediments.

Sources and concentrations of dissolved solids and selenium in the San Joaquin River and its tributaries, California, were assessed by a mass-balance approach to determine the effects of tile-drain water and irrigation-return flows on the river. The study included low-flow periods from October 1985 to mid-February 1986 and mid-May 1986 through March 1987, and a high-flow period from mid-February to mid-May 1985. During the combined low-flow period, the dissolved-solids load from eastside tributaries and the upper San Joaquin River accounted for only 18% of the total load at Vernalis, located farthest downstream, even though they accounted for 71% of the streamflow. Salt and Mud Sloughs contributed 40% of the dissolved-solids load but only 9% of streamflow. Unmeasured sources of dissolved solids contributed about 42% of the total load during low flow. In contrast, Salt and Mud Sloughs, which receive most of the tile-drain water that enters the river, contributed almost 80% of the total selenium load to the river, and loading of selenium concentrations were highest in Salt and Mud Sloughs and decreased downstream in the San Joaquin River with dilution from eastside tributaries. A State standard for dissolved solids of 500 mg/L was exceeded 11% of the time in the San Joaquin River at Vernalis. The U.S. Environmental Protection Agency's 4-day average aquatic-life criterion of 5 micrograms/L of selenium was exceeded in more than 60% of the samples from the sloughs and in about 20% of the samples from the San Joaquin River, just downstream of the Merced River. (USGS)
W89-13327

INVESTIGATION OF SHALLOW GROUNDWATER CONTAMINATION NEAR EAST FORK POPLAR CREEK, OAK RIDGE, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
J. K. Carmichael.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS

Water-Resources Investigations Report 88-4219, 1989. 49p, 20 fig, 6 tab, 21 ref.

Descriptors: *Oak Ridge, *Tennessee, *Groundwater pollution, *Heavy metals, *East Fork Poplar Creek, *Mercury, *Groundwater quality, Organic compounds, Metals, Radioisotopes.

Alluvial soils of the flood plain of East Fork Poplar Creek in Oak Ridge, Tennessee, are contaminated with mercury and other metals, organic compounds, and radio-nuclides originating from the Y-12 Plant, a nuclear-processing facility located within the U.S. Department of Energy's Oak Ridge Reservation. Observation wells were installed in the shallow aquifer of the flood plain, and water quality samples were collected to determine if contaminants are present in the shallow groundwater. Groundwater in the shallow aquifer occurs under water-table conditions. Recharge is primarily from precipitation and discharge is to East Fork Poplar Creek. Groundwater levels fluctuate seasonally in response to variations in recharge and evapotranspiration. During extremely dry periods, the water table drops below the base of the shallow aquifer in some flood-plain areas. Contaminants found in water samples from several of the wells in concentrations which equaled or exceeded drinking-water standards established by the U.S. Environmental Protection Agency are antimony, chromium, lead, mercury, selenium, phenols, and strontium-90. Total and dissolved uranium concentrations exceeded the analytical detection limit in nearly 70% of the wells in the flood plain. The results of water quality determinations demonstrate that elevated concentrations of most trace metals (and possibly organic compounds and radionuclides) were caused by contaminated sediments in the samples. The presence of contaminated sediment in samples is suspected to be the result of borehole contamination during well installation. (USGS)
W89-13329

CONSTRUCTION, GEOLOGIC, AND GROUNDWATER DATA FOR OBSERVATION WELLS NEAR THE SHELBY COUNTY LANDFILL, MEMPHIS, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-13335

QUALITY OF BOTTOM MATERIAL AND ELUTRIATES IN THE LOWER WILLAMETTE RIVER, PORTLAND HARBOR, OREGON.
Geological Survey, Portland, OR. Water Resources Div.
G. J. Fuhrer.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4005, 1989. 30p, 8 fig, 12 tab, 34 ref.

Descriptors: *Water pollution sources, *Heavy metals, *Pesticides, *Dredging, *Bottom sediments, *Oregon, Organic pesticides, Trace metals, Willamette River.

In October 1983 the U.S. Geological Survey, in cooperation with the U.S. Army Corp of Engineers, collected bottom-material and water samples from Portland Harbor, Oregon to determine concentrations of trace metals and organic compounds in elutriate-test filtrate and bottom material. Of the trace metals examined in bottom material, concentrations of cadmium slightly exceed those of local rocks, whereas lead and zinc exceedance is substantially larger. Of the organochlorine compounds examined in bottom material chlordane, DDD, DDE, DDT, dieldrin, and polychlorinated biphenyls (PCB's) were detected and quantified in at least 30% of the samples tested. A large DDT concentration (2,700 microgram/kilogram) near Doane Lake outlet is indicative of recent contamination. Polychlorinated biphenyls are ubiquitous in bottom sediments; median concentrations are nearly 65 micrograms/kilogram and as large as 550 microgram/kilogram. PCB loading to the Columbia River from Willamette River suspended sediment has been estimated to be 72 kilograms/year, nearly five times the PCB dredge load of 15 kilogram/year. The acid and base-neutral extractable di-n-butyl phthalate and bis (2-ethylhexyl)phthalate occur in sediments of Terminal No. 2 in concentrations as large as 1,965 and 2,200 micrograms/kilogram, respectively. Of the trace metals examined in both standard and oxic elutriate-test filtrate, only copper concentration in an oxic elutriate-test filtrate (19 micrograms/L) exceeded the water quality criteria (5.7 micrograms/L). (USGS)
W89-13336

VERTICAL DISTRIBUTION OF SELECTED TRACE METALS AND ORGANIC COMPOUNDS IN SEDIMENTS OF THE PROPOSED LOWER COLUMBIA RIVER EXPORT CHANNEL, OREGON, 1984.
Geological Survey, Portland, OR. Water Resources Div.
G. J. Fuhrer, and A. J. Horowitz.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4099, 1989. 40p, 13 fig, 11 tab, 45 ref.

Descriptors: *Water pollution sources, *Heavy metals, *Pesticides, *Dredging, *Bottom sediments, *Oregon, *Pesticides, Estuaries, Vertical distribution, Organic pesticides, Trace metals, Columbia River.

A proposal to deepen the lower Columbia River navigation channel in Oregon prompted a study of the vertical distribution of selected trace metals and organic compounds in bottom sediments. These data are needed to evaluate the effects of dredging and disposal operations. Elutriation testing of bottom material indicated chemical concentrations as large as 900 ug/L for barium, 6,500 ug/L for manganese, and 14 ug/L for nickel. The amount of oxygen present during elutriation testing of reduced bottom material was shown to have a negligible effect on manganese elutriate-test concentrations, but it did affect barium and iron concentrations. Sediment-associated organochlorine compounds detected in bottom-sediment core samples were as large as 0.1 ug/kg (micrograms/kilogram) for aldrin, 2.0 ug/kg for chlordane, 27 ug/kg for DDD, 5.0 ug/kg for DDE, 0.2 ug/kg for DDT, 0.2 ug/kg for dieldrin, 37 ug/kg for PCB's 1.0 ug/kg for PCN's and 1.0 ug/kg for heptachlor epoxide. Concentrations of cadmium, lead, and zinc in selected cores were found to exceed those of local basalts. Concentrations of cadmium, lead, and zinc were as large as 3.6 ug/g, 26 ug/g, and 210 ug/g respectively. Bottom-sediment concentrations of cadmium, chromium, copper, iron, and zinc associated with the less-than-100-micrometer size fraction are larger than those associated with the greater-than-100-micrometer fraction. (USGS)
W89-13337

WELL DATA, SURFACE-WATER DISCHARGE, AND NITRATE CONCENTRATIONS, FEBRUARY 1986--SEPTEMBER 1987, IN PARTS OF THE PASCO BASIN, WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-13340

TRACE ELEMENTS IN BED SEDIMENTS OF THE SAN JOAQUIN RIVER AND ITS TRIBUTARY STREAMS, CALIFORNIA, 1985.
Geological Survey, Sacramento, CA. Water Resources Div.
D. G. Clifton, and R. J. Gilliom.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $5.75, microfiche $4.00. USGS Water-Resources Investigations Report 88-4169, 1989. 33p, 3 fig, 14 tab, 35 ref.

Descriptors: *Bed load, *Trace elements, *Selenium, *San Joaquin River, *California, *Water pollution sources, Path of pollutants, Heavy metals.

Bed sediments were sampled at 24 sites on the San Joaquin River, California and its tributaries in October 1985 to assess the distribution of trace elements and factors affecting their concentrations. The proportion of less than 62-micrometer sediment was significantly (alpha=0.05) correlated with organic-carbon concentrations. Bed sediments from tributaries originating in the Sierra Nevada were much coarser than sediments in streams draining the Coast Range and western valley. Selenium concentrations in water have been measured. Interrelations among trace elements were examined using principal component analysis. 57% of the variance was accounted for in the first two principal components, which together show a distinct separation between sites dominated by Coast Range sediments and sites dominated by Sierra Nevada sediments. The third and fourth components accounted for 21% of the variance and distinguished the mixed-source sediments of the intermittent upper San Joaquin River from other parts of the river system. Generally, elements in bed sediments of the San Joaquin River and its tributaries were similar in concentration to elements in San Joaquin Valley soils, and concentrations were far below hazardous waste criteria. Concentrations were lower than in sediments from some polluted urban rivers and water more comparable to other rural agricultural rivers. (USGS)
W89-13342

WATER QUALITY DATA (OCTOBER 1987 THROUGH SEPTEMBER 1988) AND STATISTICAL SUMMARIES (MARCH 1985 THROUGH SEPTEMBER 1988) FOR THE CLARK FORK AND SELECTED TRIBUTARIES FROM GALEN TO MISSOULA, MONTANA.
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-13347

USE OF STABLE CARBON AND NITROGEN ISOTOPES TO TRACE THE LARVAL STRIPED BASS FOOD CHAIN IN THE SACRAMENTO-SAN JOAQUIN ESTUARY, CALIFORNIA, APRIL TO SEPTEMBER 1985.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 8I.
W89-13349

METHODOLOGY FOR ASSESSMENT OF CONTAMINATION OF THE UNSATURATED ZONE BY LEAKING UNDERGROUND STORAGE TANKS.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
F. A. DiGiano, C. T. Miller, A. C. Roche, and E. D. Wallingford.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-193387/AS. Price codes: A05 in paper copy, A01 in microfiche. North Carolina Water-Resources Research Institute, Raleigh, Completion Report No. 242, November 1988. 71p, 29 fig, 11 tab, 35 ref. State project 70057.

Descriptors: *Groundwater pollution, *Organic wastes, *Oil pollution, *North Carolina, Water pollution sources, Pesticides, Petroleum products.

The groundwater resources in North Carolina and the United States have been contaminated by a variety of volatile organic pollutants that include solvents, petroleum products, and pesticides. This work focused on the investigation of three methods for measuring a contaminant distribution in the subsurface: an ultrasonic, mixed-solvent, solid-core extraction method; a nitrogen-purge, solid-core extraction method; and a driveable ground-probe, vapor-phase sampling method. Laboratory results demonstrate the theoretical basis and performance of each method, while an investigation at a Camp Lejeune site provided a field trial. Method development and testing are presented in detail for all methods. The best results in the field were obtained with the ultrasonic, mixed-solvent, solid-core extraction method and the driveable ground-probe, vapor-phase sampling method. Field data results show that concentrations in each phase may

be roughly predicted by assuming equilibrium among all phases. (Lambert-UNC, WRRI)
W89-13352

SOIL CHEMISTRY AND PHOSPHORUS RETENTION CAPACITY OF NORTH CAROLINA COASTAL PLAIN SWAMPS RECEIVING SEWAGE EFFLUENT.
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5D.
W89-13353

GROUNDWATER QUALITY ASSESSMENT OF THE DELMARVA PENINSULA, DELAWARE, MARYLAND, AND VIRGINIA--ANALYSIS OF AVAILABLE WATER QUALITY DATA THROUGH 1987.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-13366

HYDROLOGICAL AND METEOROLOGICAL DATA FOR AN UNSATURATED ZONE STUDY NEAR THE RADIOACTIVE WASTE MANAGEMENT COMPLEX, IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO--1985-86.
Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 5E.
W89-13373

SELECTED GROUNDWATER DATA, CHESTER COUNTY, PENNSYLVANIA.
Geological Survey, Malvern, PA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-13374

RADIONUCLIDES IN GROUNDWATER AT THE IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO.
Geological Survey, Idaho Falls, ID. Water Resources Div.
L. L. Knobel, and L. J. Mann.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-731, Dec 1988. 37p, 7 fig, 3 tab, 27 ref. Contract DE-AI07-81ID12306. Project ID 165.

Descriptors: *Water pollution sources, *Groundwater pollution, *Data collections, *Radioisotopes, *Idaho, Radioactive wastes, Water analysis.

Sampling for radionuclides in groundwater was conducted at the Idaho National Engineering Laboratory during September to November 5 1987. Water samples from 80 wells that obtain water from the Snake River Plain aquifer and 1 well that obtains water from a shallow, discontinuous perched-water body at the Radioactive Waste Management Complex were collected and analyzed for tritium, strontium-90, plutonium-238, plutonium-239, -240 (undivided), americium-241, cesium-137, cobalt-60, and potassium-40--a naturally occurring radionuclide. The groundwater samples were analyzed at the Idaho National Engineering Laboratory in Idaho. Tritium and strontium-90 concentrations ranged from below the reporting level to 80.6 +/-0.000005 and 193 +/-3x10 to the minus eight micrograms Ci/ml, respectively. Water from a disposal well at Test Area North--which has not been used to dispose of waste water since September 1972--contained 122 +/-9x10 to the minus eleven micrograms Ci/ml of plutonium-238, 500 +/-20x10 to the minus eleven of plutonium-239, -240 (undivided), 21 +/-4x10 to the minus eleven micrograms Ci/ml of americium-241, and 750 +/-20x10 to the minus eight micrograms Ci/ml cesium-137; the presence of these radionuclides was verified by resampling and reanalysis. The disposal well had 8.9 +/-0.0000009 micrograms Ci/ml of cobalt-60 on October 28, 1987, but cobalt-60 was not detected when the well was resampled on January 11, 1988. Potassium-40 concentrations were less than the reporting level in all wells. (USGS)
W89-13377

ALASKA INDEX: STREAMFLOW, LAKE LEVELS, AND WATER QUALITY RECORDS TO SEPTEMBER 30, 1988.
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-13378

USE OF GROUND PENETRATING RADAR TO DEFINE RECHARGE AREAS IN THE CENTRAL SAND PLAIN.
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2F.
W89-13382

ETHYLENE DIBROMIDE (EDB) TRENDS IN THE UPPER FLORIDAN AQUIFER, SEMINOLE COUNTY, GEORGIA, OCTOBER 1981 TO NOVEMBER 1987.
Geological Survey, Doraville, GA. Water Resources Div.
J. B. McConnell.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4034, 1988. 11p, 4 fig, 1 tab, 6 ref.

Descriptors: *Water quality, *Path of pollutants, *Pesticides, *Organic pesticides, *Georgia, *Groundwater pollution, Agricultural chemicals, Halogenated pesticides, Floridan Aquifer.

Results of an investigation to assess the persistence and trends of ethylene dibromide (EDB) in the Upper Floridan aquifer, in Georgia indicate that in November 1987, EDB was present in the groundwater 4 years after it was last applied as a soil fumigant in the intensively farmed area of central Seminole County. At that time, EDB was detected in water samples from one domestic well and four irrigation wells. Concentrations ranged from less than 0.01 micrograms/L to 3.3 micrograms/L. The investigation in November 1987 revealed the groundwater contamination was limited to the 4-sq-mi area in the vicinity of Buck Hole, a sinkhole in a swampy depression in the central part of the County. In three of the five wells in which EDB was detected, concentrations have not changed significantly since August 1983. However, in one irrigation well near Buck Hole, the concentration decreased from 110 to 0.7 microgram/L since October 1981. In another irrigation well near Buck Hole, the concentration decreased from 26 to about 2.5 microgram/L during that period. The groundwater level data indicate that from Buck Hole, the hydraulic gradient in the Upper Floridan aquifer is about 2.8 ft/mi toward the east. However, the movement of EDB from the area of relatively high concentration near Buck Hole in the direction of inferred flow lines is not apparent. Although concentration gradients were not detected along flow lines, the movement of water induced by pumping wells W4 and W5 produced short-term decreasing and increasing trends in EDB Concentrations in wells W4 and W5, respectively. (USGS)
W89-13386

NATIONAL WATER SUMMARY 1986--HYDROLOGICAL CONDITIONS AND GROUNDWATER QUALITY.
Geological Survey, Reston, VA. Water Resources Div.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-202691/AS. Price codes: A22 in paper copy only. USGS Water-Supply Paper 2325, 1988. 560p, 315 fig, 10 tab. Compiled by D. W. Moody, J. E. Carr, E. B. Chase, and R. W. Paulson.

Descriptors: *Groundwater quality, *Groundwater pollution, *Groundwater management, *United States, *Hydrology, *Nonpoint pollution sources, *Water pollution sources, Ambient groundwater quality, Radon, Waste sites.

This report, the fourth of an annual series describing the Nation's water resources, focuses on groundwater quality and summarizes the ambient quality of groundwater in the principal water-supply aquifers and describes the nature and extent of groundwater contamination in each state, the District of Columbia, and the territories. Each summary contains multicolor illustrations that show selected geographic features and the 1985 population distribution; the location of principal aquifers and presentations of data related to water quality in those principal aquifers; and the location of selected waste sites, areas of naturally impaired groundwater quality, and areas reflecting human-induced contamination. Also summarized are the State agencies, laws, and regulations involved in groundwater quality management. Other parts of the report provide a review of significant hydrologic events in the 1986 water year; describe the major factors that control groundwater quality and illustrate by six case studies the ways in which groundwater can become contaminated from point and nonpoint sources and the water quality changes that take place as the contaminants move through the flow system; and discuss the role of the U.S. Environmental Protection Agency and the Federal Government in groundwater protection, and the results of a study of State and local groundwater protection strategies conducted by the National Research Council. A selected listing of chemicals and common names of organic compounds referenced in the report and a tabulation of national primary and secondary drinking-water regulations complete the report. (USGS)
W89-13395

COMPUTATION OF THREE-DIMENSIONAL ADVECTION-DOMINATED SOLUTE TRANSPORT IN SATURATED AQUIFERS.
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
A. D. Koussis, D. Syriopoulou, and G. Ramanujam.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-214472/AS. Price codes: A07 in paper copy, A01 in microfiche. Final Report, January 1989. 132p, 64 fig, 11 tab, 57 ref. USGS Contract 14-08-0001-G1296.

Descriptors: *Model studies, *Solute transport, *Computer models, *Advection, Saturated aquifers, Groundwater, Water pollution sources, Path of pollutants, Landfills, Dispersivity, Two-dimensional models, Simulation analysis, Three dimensional models.

The objective has been to deliver an accurate and efficient computational tool for three-dimensional groundwater solute transport with grid sizes and resolution required for field applications that will enable geohydrologists to carry out routinely a credible analysis and prediction of groundwater contamination. Efficient methodologies have been devised that acknowledge the nature of advection-dominated transport, and address the problem of transverse numerical diffusion caused by grid anisotropy. A suite of models has been constructed suitable for simulating transport in a steady flow field. The final tests entailed simulation of the chloride plume observed under the Borden landfill in Ontario, Canada. The 2-D and a 3-D simulation study can be quite different. These conclusions should be accepted as being site specific and somewhat impaired by the uncertainty of data on 3-D domain geometry, on surface definition and on concentration distribution. (USGS)
W89-13396

ESTIMATING POTENTIAL GROUND AND SURFACE WATER POLLUTION FROM LAND APPLICATION OF POULTRY LITTER-II.
Arkansas Univ., Fayetteville. Dept. of Agronomy.
D. C. Wolf, J. T. Gilmour, and P. M. Gale.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-214365/AS. Price codes: A03 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Publication No. 137, June 1988. 34p, 9 fig, 6 tab, 29 ref. USGS Project G-1409-3.

Descriptors: *Nitrogen, *Manure, *Farm wastes, *Nutrients, Water quality, Arkansas, Waste disposal, Water pollution sources, Pollutant identification, Land disposal.

In Arkansas, approximately 1 Tg of poultry (Gallus gallus domesticus) manure and litter is produced annually. These waste products are commonly applied to pastures as a soil amendment or fertilizer, but excessive application rates and poor management practices could result in nutrient contamination of ground and surface water. The purpose of this study was to: (1) assess the nutrient concentrations in poultry manure and (2) evaluate the nitrogen loss from land-applied poultry litter and manure due to ammonia volatilization. Analyses for total Kjeldahl nitrogen (TKN), inorganic nitrogen (N), phosphorus (P), and potassium (K) were compared in 12 wet and dry hen manure samples. Drying the manure reduced the TKN from 57 to 40 g N/kg on a dry weight basis in wet and dry manure, respectively. The N sub i in the manure was in the ammoniacal form with values of 19 and 2 g N/kg for wet and dry manure, respectively. The P and K levels were not influenced by drying the manure and had values of 24 and 21 g/kg, respectively. The results indicate that the nitrogen content of hen manure can be significantly reduced by drying the sample prior to analysis. In a 10-day laboratory study and an 11-day field study to evaluate ammonia volatilization from surface-applied hen manure, results indicated that 37% of the total nitrogen content in surface-applied poultry waste can be lost due to ammonia volatilization. Results indicate that soil and environmental conditions play a critical role in determining the potential for nitrate pollution of ground and surface water when poultry manure and litter are surface-applied to pastures. (Wolf-AR U., WRRC)
W89-13399

INFLUENCE OF DISCHARGE AND URBANIZATION ON THE CONCENTRATION, SPECIATION, AND BIOAVAILABILITY OF TRACE METALS IN THE RARITAN RIVER, NEW JERSEY.
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Geological Sciences.
F. McLaughlin, G. M. Ashley, and W. H. Renwick.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-214449/AS. Price codes: A05 in paper copy, A01 in microfiche. Center for Coastal and Environmental Studies, New Brunswick, NJ. Final Report 1988. 73p, 20 fig, 15 tab, 80 ref, 2 append. Contract 14-08-0001-G1240. USGS Project G1240-07.

Descriptors: *New Jersey, *Raritan River, *Pollutant identification, *Trace metals, *Urbanization, Water pollution sources, Water quality, Rivers, Trace elements, Suspended sediments, Heavy metals, Spectrometry, Speciation, Bioavailability, Discharge.

The Raritan River and its tributaries are a vital drinking water and recreational resource in central New Jersey. These waters also serve as disposal media for municipal and industrial wastes and urban stormwater runoff. Rapid development over the last several decades has intensified the pressures on the quality and use of Raritan waters. The concentration and speciation of ten trace metals (Ag, As, Cd, Cr, Cu, Co, Hg, Ni, Pb, Zn) were investigated in the Raritan Basin. From September 1985 to April 1987, 120 depth-integrated samples were collected at four locations and analyzed by Direct-Current Plasma Atomic Emission Spectrometry (DCP-AES) for concentrations of dissolved, particulate-associated, total, and suspended sediment trace metals. The suspended sediment underwent sequential extraction following techniques which define five geochemical species of trace metals within particulates: exchangeable, carbonate, Fe/Mn oxide, organic, and residual. The concentrations of trace metals readily available, potentially available, and not available to aquatic and terrestrial biota are also reported. Discharge is the most important factor influencing the concentration and speciation of trace metals in the Raritan River and its tributaries. Seasonal variations affect speciation patterns, but have a minor impact on concentration and availability to biota. The subbasin draining a more urbanized area in the Raritan Basin appeared to have elevated concentrations and increased biological availability of trace metals relative to less urbanized basins. (McLaughlin-Rutgers U.)
W89-13402

EVALUATION OF METHODS FOR THE ESTIMATION OF TRIBUTARY MASS LOADING RATES.
Purdue Univ., Lafayette, IN. Water Resources Research Center.
S. D. Preston, V. J. Bierman, and S. E. Silliman.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-217574/AS. Price codes: A04 in paper copy, A01 in microfiche. Technical Report No. 187, June 1989. 50p, 14 fig, 4 tab, 35 ref. USGS Contract 14-08-0001-G1561. USGS Project G1561-04.

Descriptors: *Tributaries, *Loading distribution, *Phosphorus, *Statistical methods, *Estimating, Estimate error, Beales Ratio estimation.

Tributary loading estimation methods were evaluated for application to a range of tributary types including highly event responsive systems. Evaluations were performed by conducting retrospective studies with comprehensive sets of field data for flow rates and total phosphorus concentrations. Four estimators from three broad categories were selected for study based on their performance in previous research. Estimators were evaluated using Monte Carlo sampling studies in which random subsamples of complete loading records were used to estimate annual mass loads. These estimates were then compared to 'true' loads determined by calculations using the entire record. Beale's Ratio Estimator consistently provided unbiased estimates, although stratification was necessary under event sampling. Differences in hydrograph characteristics played a strong role in the overall level of estimate error and in the amount of bias in averaging and regression estimators. Characteristics that are hypothetically responsible for the level of estimate error in different tributaries include frequency, magnitude, and duration of high flow events. Sensitivity studies are currently underway to determine which of these characteristics introduce the greatest error. Daily flow simulation models to be used in sensitivity studies are described. (Wright-Purdue U.)
W89-13405

CONTRIBUTION OF SUBSOIL AND AQUIFER MICROORGANISMS TO GROUNDWATER QUALITY.
Purdue Univ., Lafayette, IN. Water Resources Research Center.
R. F. Turco.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-217566/AS. Price codes: A05 in paper copy, A01 in microfiche. Technical Report No. 177, June 1989. 30p, 10 fig, 3 tab, 20 ref. USGS Contract 14-08-0001-G1561. USGS Project G1561-02.

Descriptors: *Subsoil, *Groundwater, *Microbial degradation, *Biodegradation, *Soil bacteria, Pesticides, Atrazine, Metolachlor, Alachlor, Microbial degradation, Microbial biomass.

Little information about the microbiology of the subsurface environment is available. This study was conducted to better understand the microbiology and microbial processes that occur in the subsurface under a typical midwestern agricultural soil. A 26 m bore was installed in November of 1988. Sterile collections of soils were made at 17 different depths. A physical as well as biological investigation of the subsurface materials was conducted. Among the measured parameters were particle size analysis, carbon, carbonates, nitrogen, phosphorus, potassium, and water holding capacity. The level of three pesticides, atrazine, metolachlor, and alachlor was determined. Microbial biomass was assessed using direct counts, phospholipid content, and plate counts. The ability of microbial populations resident in the strata to use glucose, phenol, aniline, 14C-ring labeled 2-methyl-6-ethyl-aniline, 14C-ring labeled metolachlor, 14-C-carbonyl labeled metolachlor, and atrazine was assessed. Physical analysis indicated that the site contained up to 17 different strata. The site materials were primarily glacial tills with high carbonate content. Microbial numbers and activity in the tills was much lower than either in the surface materials or the aquifer located at 25m. (Wright-Purdue)
W89-13406

5C. Effects Of Pollution

ACID PRECIPITATION EFFECTS ON GROWTH AND YIELD RESPONSES OF TWENTY SOYBEAN AND TWELVE SNAP BEAN CULTIVARS.
North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Plant Science and Technology.
M. R. Reddy.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 145-148, April/June 1989. 7 tab, 16 ref.

Descriptors: *Acid rain effects, *Plant growth, *Crop yield, *Soybeans, *Beans, *Nutrients, Precipitation, Greenhouses, Acid rain, Simulated rainfall, Yield, Growth, Water pollution effects, Cultivars.

Greenhouse studies were conducted to determine the effects of simulated acid precipitation on growth, yield, and nutrient content of soybean (Glycine max (L.) Merr.) and snap bean (Phaseolus vulgaris L.). Twenty cultivars of soybean and twelve cultivars of snap bean were grown in pots and treated with simulated precipitation at pH 2.5, 3.5, 4.5, or 5.6 (control). Soybean and snap bean plants were treated with simulated precipitation once a week beginning until fruit maturity. Soybean plants showed leaf scorching and yellowing of leaves at pH 2.5 and 3.5, whereas snap bean did not show any visible symptoms. Soybean and snap bean cultivars responded differently to acid precipitation treatments. McNair 700 and Pioneer 5482 soybean and Commodore bush and Provider bush snap bean cultivars yields were decreased significantly under acid treatments. Eighteen soybean and 10 snap bean cultivars were unaffected. In general, acid precipitation treatments resulted in a greater number of soybean pods without seed compared to the control. Treatments at pH 3.5 and 2.5 affected soybean and snap bean growth and yield more than the other pH levels. Potassium content of soybean shoot decreased significantly under acid precipitation treatments, whereas Ca, Mg, and micronutrients contents were not affected by low pH treatment. Nutrient content of snap bean was unaffected by acidity. (Author's abstract)
W89-12174

DIRECT EFFECTS OF SIMULATED ACID RAIN ON SEXUAL REPRODUCTION IN CORN.
North Carolina State Univ. at Raleigh. Air Quality Research Program.
D. T. DuBay.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 217-221, April/June 1989. 2 fig, 2 tab, 33 ref. USDA/CSRS Competitive Research Grant no. 85-CRCR-1-1769 and Specific Cooperative Agreement 58-43YK-7-0001.

Descriptors: *Water pollution effects, *Acid rain effects, *Acid rain, *Simulated rainfall, *Corn, *Crop production, Flowering, Sexual reproduction, Pollinization.

The process of sexual reproduction in flowering plants often exposes pollen grains to the environment and the potential effects of atmospheric deposition. Experiments were designed to determine whether simulated acid rain treatments just before or after pollinization could adversely influence reproductive processes and seed set in corn (Zea mays L.). Container-grown corn with sexually mature tassels and ears were exposed once too the simulated rain at four pH levels for 1 hour, beginning with 1 hour after artificial pollination or ending w10 minutes before artificial pollination.

The single, artificial pollination deposited an average of 85 pollen grains per silk. Simulated rain treatment at pH 4.5, 3.5, or 2.5 after pollination reduced the percentage seed set of treated ears 7, 29 and 34%, respectively, as compared with pH 5.5. Simulated rain at pH 5.5 after pollination reduced seed set 24% as compared with no-rain controls. The pH of simulated rain applied before pollination did not affect seed set, and pH 5.5 rain applied before pollination had no effects on seed set compared to no-rain controls. Microscopic observations indicted that pollen germination and pollen tube penetration of the silk were completed by the time the rain treatments began 1 hour after pollination. This infers that simulated acid rain influenced pollen tubes after they entered the silks. These results suggest that plant sexual reproduction could be adversely affected by acidic precipitation at pH levels observed for rain events in eastern North America. (Author's abstract)
W89-12184

TEMPORAL VARIATION IN NITRATE AND NUTRIENT CATIONS IN DRAINAGE WATERS FROM A DECIDUOUS FOREST.
Great Lakes Forestry Research Centre, Sault Sainte Marie (Ontario).
N. W. Foster, J. A. Nicolson, and P. W. Hazlett.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 238-244, April/June 1989.

Descriptors: *Forest watersheds, *Acid rain effects, *Leaching, *Weathering, *Soil solution, *Nitrates, *Nutrients, *Deciduous forests, Cations, Streams, Temporal distribution, Drainage water, Forests, Ontario.

Temporal variations in soil solution and stream chemistry were examined in 1984 in an undisturbed sugar maple-yellow birch (Acer saccharum Marsh.-Betula alleghaniensis Britton) forest in the Turkey Lakes Watershed, Ontario. Nitrate was the dominant anion associated with cation depletion from soil. Nitrogen in precipitation was less important than soil N in the determination of solution chemistry. Growing season increases in NH4(+) and NO3(-) in soil solution were greatest in the Oe horizon and decreased with depth. Nitrate concentration in mineral soil solution and streamwater were highest during the dormant period and peaked at the start of spring snowmelt. Although NO3(-) concentrations in streamwater were positively correlated (r = 0.7-0.9) with NO3(-) and Ca(++) concentrations in mineral soil solution during the dormant period, NO3(-) contributed far less to cation fluxes in streamwater than HCO3(-) or SO4(--). (Author's abstract)
W89-12187

RISK OF INFECTION FROM GIARDIA LAMBLIA DUE TO DRINKING WATER SUPPLY, USE OF WATER, AND LATRINES AMONG PRESCHOOL CHILDREN IN RURAL LESOTHO.
Johns Hopkins Univ., Baltimore, MD. Dept. of International Health.
S. A. Esrey, J. Collett, M. D. Miliotis, H. J. Koornhof, and P. Makhales.
International Journal of Epidemiology IJEPBF, Vol. 18, No. 1, p 248-253, March 1989. 4 tab, 38 ref. USAID grant no. 632-0088-5-00-4012-00.

Descriptors: *Water pollution effects, *Risk assessment, *Infection, *Giardia, *Protozoa, *Water supply, *Water use, *Public health, *Rural areas, *Lesotho, *Drinking water, *Parasites, Rural populations, Feces, Developing countries.

Stool samples were collected from 267 rural, preschool children in four districts in Lesotho during October-November, 1984. Sixty-three children (23.6%) were tested positive for Giardia lamblia, the most commonly recovered parasite from stool samples. The use of low amounts of water for personal hygiene was associated significantly with having G. lamblia (Odds Ratio = 2.42), but the use of traditional, non-improved drinking water sources (OR = 1.38) or lack of latrines (OR = 0.94) was not. Although G. lamblia may be primarily waterborne in developed countries, the amount of water that is used for personal and domestic hygiene may be more important than the quality of the drinking water in developing countries. Other risk factors that were identified to be associated significantly with having or not having Giardia were children older than 24 months (OR = 6.79), mother less than 20 years of age (OR = 5.18), residing in Mohales Hoek district (OR = 2.33), and possessing several agricultural tools (OR = 0.70). (Author's abstract)
W89-12201

COMMUNITY-WIDE EPIDEMIOLOGICAL INVESTIGATION OF A TYPHOID OUTBREAK IN A RURAL TOWNSHIP IN TAIWAN, REPUBLIC OF CHINA.
Soochow Univ., Taipei (Taiwan). Dept. of Microbiology.
C. King, C. Chen, S. You, Y. Chuang, and H. Huang.
International Journal of Epidemiology IJEPBF, Vol. 18, No. 1, p 254-260, March 1989. 2 fig, 3 tab, 23 ref.

Descriptors: *Water pollution effects, *Human diseases, *Epidemiology, *Taiwan, *Rural areas, Rural populations, Salmonella, Escherichia coli.

An outbreak of typhoid fever occurred in Chu-Tung township, Taiwain, with dates of onset from 6 July to 8 August, 1983. Fifty-four cases were hospitalized, of which 52 were laboratory confirmed. A chloromphenicol-resistant strain of Salmonella typhyi was isolated from patients' blood samples. A community survey of 2772 people selected from 490 households by stratified systematic cluster sampling, presented an attack rate of 9.4 per 1000 and a case reporting rate of 10%. The attack was higher in males than females for persons younger than ten years, but was greater in females than in males aged 40 years and older. The only consistent characteristic of the early outbreak cases was drinking of tapwater (10/10, 100% versus 319/490, 65% of the controls). None of the early cases and 36% (13/36) of the late cases had drunk stream or river water. Households of early cases had better hygienic conditions than those in the late cases. Laboratory examination of environmental specimens indicated Escherichia coli contamination of tapwater, well water and all stream foci associated with human activities. The epidemiological data combined with laboratory results suggested that the epidemic might be due to repeated contamination of some common source (such as municipal tapwater) and/or a variety of other vehicles. (Author's abstract)
W89-12202

SWIMMING-ASSOCIATED ILLNESS AND RECREATIONAL WATER QUALITY CRITERIA.
Rhode Island Univ., Kingston. Dept. of Microbiology.
V. J. Cabelli.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 13-21, 1989. 3 tab, 29 ref.

Descriptors: *Human diseases, *Recreation, *Swimming, *Water pollution, *Feces, *Infection, *Sewage bacteria, *Viruses, *Public health, *Epidemiology, *Water quality standards, Reviews, Gastroenteritis, Wastewater treatment, Chlorination.

There is a measurable risk of acute gastroenteritis associated with swimming in marine waters contaminated with human fecal wastes to levels that would be aesthetically acceptable. The enterococcus level in the bathing water is the best single measure of its quality relative to the risk of swimming-associated, pollution-related infectious disease. Three mathematically expressible indicator-illness relationships (criteria) are available from which recreational water quality guidelines can be extrapolated from the criteria once a decision has been made as to the acceptable risk of illness. The recently revised USEPA recreational water quality criteria and guidelines reflect this regulatory approach. A model is presented for the regulation of water quality which defines decision-making and actions by federal nd local agencies as well as resource users. This model requires the ability to predict illness rates from monitoring data. Three equations, each corresponding to one of the criteria, are available for doing so. Concept and supporting epidemiological data indicate that the criteria do not apply to situations in which the sources of contamination are the fecal wastes from small numbers of individuals (e.g. boat wastes, the bathers themselves) or from lower animals (e.g. stormwater run-off). Differential die-off of viral pathogens and the bacterial indicator during wastewater chlorination and protracted residence in marine waters may also confound the use of the criteria in specific situations. (Author's abstract)
W89-12204

IMPACT OF MARINAS ON WATER QUALITY.
Queensland Dept. of Environment, Conservation and Tourism, Brisbane (Australia). Div. of Water Quality.
For primary bibliographic entry see Field 5B.
W89-12207

ECOTOXICOLOGY OF SHALE OIL COMPONENTS TO MARINE BACTERIA.
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
M. S. J. Warne, D. W. Connell, and D. W. Hawker.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 135-139, 1989. 2 tab, 8 ref.

Descriptors: *Water pollution effects, *Pollutants, *Oil shale, *Toxicity, *Marine bacteria, *Organic compounds, Alkanes, Alkenes, Pyridines.

The toxicity of 32 shale oil components to a mixed marine bacterial culture and the mode of toxic joint action in mixtures of the components was assessed. The great bulk of shale oil (alkanes and alkenes) was of very low toxicity. The pyridines were the most hazardous group of compounds tested. Based on differences in chemical structure it was not possible to predict the mode of joint action between compounds. The form of interaction in mixtures was both additive and synergistic. Thus the addition of the toxicity of individual components of shale oil would greatly underestimate the oil's true toxicity. (Author's abstract)
W89-12222

COMPARISON OF TECHNIQUES FOR ASCERTAINING THE IMPACT OF A THERMAL DISCHARGE ON THE TEMPERATURE OF TIDAL RECEIVING WATERS.
Queensland Electricity Commission, Brisbane (Australia). Environmental Investigations Branch.
C. W. Ross, and M. A. Curtis.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 195-198, 1989. 3 fig, 2 ref.

Descriptors: *Estuaries, *Tidewater, *Powerplants, *Thermal pollution, *Water temperature, *Monitoring, *Remote sensing, *Water pollution effec.s, Calliope River, Australia, Temperature effects.

Investigations were carried out over the period 1975-85 to determine the extent and magnitude of changes in the thermal environment of the Calliope River estuary attributable to the operation of the Gladstone Power Station. A review is given of the relative advantages and limitations of the following techniques used in the investigations: intermittent monitoring at 30 sites on 500 days over 10 years; continuous monitoring at a small number of sites; remote sensing by aircraft; and intensive studies focussing upon determining tidal influences. Information is presented on the measured increase in river temperatures above natural background levels. The techniques provide different information and complement each other. A judicious mix of monitoring techniques is necessary to obtain a detailed assessment of thermal discharge effects due to the dynamic nature of tidal waters. (Author's abstract)
W89-12229

IMPACT OF CATCHMENT URBANISATION ON LAKE MACQUARIE (AUSTRALIA).
State Pollution Control Commission, Lidcombe (Australia).
For primary bibliographic entry see Field 4C.
W89-12231

REVIEW OF WATER QUALITY AND MANAGEMENT PROBLEMS IN CANAL ESTATES IN WESTERN AUSTRALIA.
Waterworks Commission, Perth (Australia).
R. P. Atkins.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 217-221, 1989. 1 fig, 1 tab, 4 ref.

Descriptors: *Estuaries, *Tidewater, *Canals, *Water quality management, *Eutrophication, *Australia, Algae, Phytoplankton, Oxygen depletion, Odors, Fishkill, Dredging, Destratification, Urban planning.

Canal estates is western Australia are located on the Peel-Harvey Estuarine System, a nutrient enriched waterbody with excessive growths of both macroalgae and phytoplankton. Yunderup Canals have poor water quality exhibiting typical symptoms including frequent phytoplankton blooms, depressed oxygen levels, odor emissions and fish kills. Water in Waterside Mendurah Canals is marginally poorer than that on the Peel Inlet Channel but within an acceptable range. The differences between developments is related to the proximity of the ocean and therefore tidal action. Canal water quality projections are made. Options to improve canal water quality include artificial de-stratification, improved exchange, dredging, and nitrate injection to immobilize phosphorus in sediments. For existing canal estates, it is suggested that the most practical option is to do nothing until the deterioration of water quality and consequent impact on life styles justifies the cost of dredging. It is further suggested that new canal developments should not be located in estuaries in the southwest of Western Australia where tidal exchange is poor. (Sand-PTT)
W89-12233

BIOLOGICAL ASPECTS OF WATER MANAGEMENT.
Capricornia Inst. of Advanced Education, Rockhampton (Australia). Dept. of Biology.
L. G. Cook, K. M. Harrower, and A. P. Mackey.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 237-240, 1989. 2 ref.

Descriptors: *Water pollution effects, *Water quality management, *Water quality control, *Wastewater disposal, *Water pollution, *Recreation, *Sport fishing, *Eutrophication, Reviews, Hydrocarbons, Pesticides, Industrial wastewater, Fisheries, Municipal wastewater, Biological oxygen demand, Water supply, Turbidity, Dissolved oxygen, Ammonium, Bacteria, Boating.

The microbiological aspects of the accumulation of xenobiotic and non-xenobiotic substances from industrial and domestic waste water treatments are reviewed, with particular reference to hydrocarbons, pesticides and inorganic plant nutrients. It is argued that if water bodies are to be used to establish recreational fisheries as well as for water supply and effluent disposal, then the management aim may need to be one of controlled eutrophication. Ramifications of this proposal are considered. The biological aspects of the impact of other recreational and amenity uses of water bodies on water and environmental quality is briefly described. Water turbidity, dissolved oxygen and BOD levels, ammonium concentration, pH and bacterial counts are all affected by the discharge of human wastes. Boating activities may also cause a severe deterioration of water quality. The training required by potential water managers therefore, includes biological and chemical skills involved with pollution survey and control and also an understanding of the wide variety of uses water bodies may have and the management options available. (Sand-PTT)
W89-12236

WATER QUALITY AND MANAGEMENT IN THE GREAT BARRIER REEF MARINE PARK.
Great Barrier Reef Marine Park Authority, Townsville (Australia).
For primary bibliographic entry see Field 5B.
W89-12241

IMPACT OF LAGOON EFFLUENT ON AN INLAND STREAM: A 10 YEAR PERSPECTIVE.
WSL Consultants Pty Ltd., Richmond (Australia).
For primary bibliographic entry see Field 5E.
W89-12244

NO ADVERSE ENVIRONMENTAL IMPACTS FROM WATER PLANT DISCHARGES.
Illinois State Water Survey Div., Peoria. Water Quality Section.
For primary bibliographic entry see Field 5F.
W89-12249

METABOLISM OF A FOULING COMMUNITY. COMMUNICATION 1. DYNAMICS OF SPECIES COMPOSITION, BIOMASS, MICROHETEROTROPHS AND POB IN THE MEDIUM WITH A COMMUNITY AT DIFFERENT STAGES OF ITS FORMATION (METABOLIZM SOOBSHCHESTVA OBRASTANII. SOOBSHCHENIE I. DINAMIKA VIDOVOGO SOSTAVA, BIOMASSY MIKROGETEROTROFOV I P.O.B. V SREDE S SOOBSHCHESTVOM NA RAZNYKH STADIYAKH EGO FORMIROVANIIA).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
For primary bibliographic entry see Field 2L.
W89-12251

INFLUENCE OF UREA TOP DRESSING OF FOREST WATER CATCHMENT AREAS ON THE BIOLOGICAL SUFFICIENCY AND WATER QUALITY IN MOUNTAIN STREAMS. I. HYDROCHEMICAL AND SAPROBIOLOGICAL ASSESSMENT (VLIYANIE NA TORENETO S UREYA NA GORSKI VODOSBORI V'RKHU BIOLOGICHNATA P'LNOTSENNOST I KACHESTVATA NA VODITE V PLANINSKI POTOTSI. I. KHIDROKHIMICHNA I SAPROBIOLOGICHNA OTSENKA) (IN BULGARIAN).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 5B.
W89-12256

EFFECT OF SOME HEAVY METALS (COPPER, LEAD, ZINC, CADMIUM) ON BACTERIA, PROTOZOA AND ALGAE (VLIYANIE NA NYAKOI TEZLKI METALI (MED, TSINK, OLOVO, KADMII) V'RKHU BOKTERII PROTOZOA I VODORASLI)(IN BULGARIAN),
Academy of Medicine, Sofia (Bulgaria). Research Inst. for Hygiene.
S. I. Terzieva, S. E. Danon, R. B. Detcheva, and T. G. Toncheva-Panova.
Hydrobiologia HYDRB8, Vol. 25, p 30-41, 1985. 5 fig, 42 ref. English summary.

Descriptors: *Water pollution effects, *Heavy metals, *Species diversity, *Bacteria, *Algae, *Protozoa, Copper, Zinc, Lead, Cadmium, Escherichia coli, Enterobacter, Klebsiella, Self-purification, Water quality.

The effect of some heavy metals (copper, zinc, lead, cadmium) on representatives of the aquatic community was studied at the maximum permissible concentration and at concentrations that occur frequently in practice. The metal ions affected bacteria, protozoa and algae in a similar manner. In the case of bacteria there was species impoverishment, mainly at the expense of species belonging to the Escherichia, Enterobacter and Klebsiella genera. The metals also had a marked inhibitory effect on nitrifying bacteria. A sharp decrease in the species diversity was also found for protozoa, the most sensitive Protozoa species to almost all metals being Glaucoma chattoni, Uronema Nariunm and Colpidium campylum, which disappeared in the early periods of the impact. Almost all of the metal ions caused an intensive reduction of algal cells. Since the microorganisms studied take an active part in the mineralization of organic matter, in the self-purification processes, it may be expected that the presence of chemical substances (heavy metals) may affect the aquatic community by changing the correlation between its various representatives, lowering their species diversity. This in turn will result in changes in the hygienic quality of the water body. (Author's abstract)
W89-12259

USE OF WATER TEST-ORGANISMS IN WASTE-DERIVED ALUMINUM SULFATE TOXICITY STUDIES IN VIEW OF ITS UTILIZATION AS A COAGULANT IN WASTE WATER TREATMENT (IZPALZVANE HA VODNI TEST-OBEKTI PRI ISLEDRANE TOKSICHNOSTTA NA ALUMIMEV SULFAT, POLYCHEN OT OTPAD CHNI PRODUKTI, S OGLED PRILAGANETO MI KATO KOAGULANT PRIPRECHISTVANE HA OTPAD' RDNI VODI)(IN BULGARIAN).
Napravlenie Nauchno-Tekhnologihni Izsledvaniia Pri Kompleksniia Nauchno-Izsledovatelski i Proektantski Institut po Blagoustroistva i Komunalno Stopanstvo, 1618 Sofia (Bulgaria).
For primary bibliographic entry see Field 5A.
W89-12260

POLLUTION AND EUTROPHICATION OF THE UPPER REACHES OF THE SAZAVA RIVER (CZECHOSLOVAKIA).
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia).
For primary bibliographic entry see Field 5B.
W89-12261

TRENDS IN CHANGES OF THE HYDROBIOLOGICAL AND SAPROBIOLOGICAL STATE OF THE TUNDZA RIVER. II. MAY-NOVEMBER 1981 (TENDENTSII V IZMENENIYATA NA KHIDROBIOLOGICHNOTO SAPROBIOLOGICHNOTO S'STOYANIE NA REKA TUNDZHA. II MAII I NOEMBRII 1981) (IN BULGARIAN).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 5B.
W89-12262

STUDIES ON THE TOXICITY OF UREA ON STREAM BENTHOCENOSES IN CONNECTION WITH AERIAL TOP-DRESSING OF FOREST WATER CATCHMENT AREAS (TOKSICHNOST NA UREYA V'PKLU BENTOTSENOZI V POTOTSITE PRI AVIOTORENE NA GORSKI VODOSBORI) (IN BULGARIAN).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
S. G. Kovachev, and Y. I. Uzunov.
Hydrobiologia HYDRB8, Vol. 26, p 37-40, 1985. 1 fig, 1 tab, 11 ref. English summary.

Descriptors: *Water pollution effects, *Ureas, *Fertilizers, *Forest watersheds, *Benthos, *Toxicity, Mortality, Species composition, Median tolerance limit.

Experiments over 24 h periods were carried out on a simulated stream benthic species composition to determine the level of toxicity of urea applied to forest water catchment areas. The established semilethal concentration (LC50 = 4.6 g/cu dm) exceeded the absolute maximum 160 times in content of nitrogen and was approximately 2000 times higher in content of ammonium than the mean concentrations in the experimental streams. The effect of the application of urea is expressed not through mortality caused by its toxicity, but through the disruption of the structure of the natural communities in the streams running through the treated water catchment areas. (Author's abstract)
W89-12263

EFFECTS OF PHENOLIC COMPOUNDS ON THE ACTIVITY OF MICROCYSTIS AERUGIN-

OSA (VLIYANIE FENOL'NYKH SOEDINENII NA ZHIZNEGEYATEL'NOST' MICROCYSTIS AERUGINOSA).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. N. Koznitskaya.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 23, No. 1, p 51-56, 1987. 4 fig, 2 tab, 11 ref. English summary.

Descriptors: *Eutrophication, *Cyanophyta, *Phenols, *Dnieper River, *Reservoirs, Photosynthesis, Algal growth.

Phenolic compounds were studied for their effect on the activity of the blue-green alga Microcystis aeruginosa Kutz emend. Elenk, which is a basic agent of eutrophication in the Dnieper reservoirs. Phenolic compounds induce changes in growth, propagation, pigment formation and photosynthesis. The action of the phenolic compounds studied depended on both their concentration and structure. (Author's abstract)
W89-12269

GENETIC EFFECTS IN THE POPULATION OF SEA-AMPHIPODS IN A MEDIUM OF ANTHROPOGENIC EUTROPHICATION (GENETICHESKIE EFFEKTY V POPULIATSII MORSKIKH AMFIPOD PRI ANTROPOGENNOM EVTROFIROVANII SREDY).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
V. G. Tsytsugina, and E. A. Kuftarkova.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 6, p 19-20, 1988. 1 fig, 2 tab, 5 ref. English summary.

Descriptors: *Water pollution effects, *Wastewater outfall, *Gammarus, *Mutagens, *Coastal waters, Amphipods, Domestic wastewater, Wastewater pollution, Laboratory studies.

Natural chromosome mutagenesis was studied in embryonic cells of Gammarus olivii, taken from the vicinity of a domestic sewage discharge and from an unpolluted coastal area. The domestic wastewater had a marked mutagenic effect. (Author's abstract)
W89-12273

EFFECT OF SURFACTANTS ON THE GROWTH OF ALGAE (VLIIANIE POVERKHNOSTNO-AKTIVNYKH VESHCHESTV NA VODOROCLI) (OBZOR).
Donetskii Gosudarstvennyi Univ. (USSR).
T. V. Parshikova, and S. F. Negrutskii.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 6, p 46-58, 1988. 88 ref. English summary.

Descriptors: *Water pollution effects, *Surfactants, *Algal growth, *Algicides, Aquatic weed control, Bactericides, Fungicides, Pigments, Enzymes, Membranes, Sorption, Permeability.

Generalized data are presented on synthetic and natural surfactants which are in water bodies as a result of their wide use in industry and agriculture as well as during the vital activity of bacteria, algae, fungi. Mechanisms of direct influence of anion-, cation-, active and nonionogenic surfactants on the functional activity of algae were analyzed as a result of changes in the state of pigments, enzymic activity, membrane permeability, sorption and desorption. Surfactants have an indirect influence on the formation of algal communities due to their bactericidal and zoocidal effects with respect to microorganisms and invertebrates. It is concluded that surfactants exert a multiple effects on the vital activity of algae of different systematic groups and are promising as natural and synthetic regulators of their growth. (Author's abstract)
W89-12275

STRUCTURAL AND FUNCTIONAL CHARACTERISTICS OF THE RIVERINE BENTHIC ORGANISMS SUBJECT TO ANTHROPOGENIC EFFECTS (STRUKTURNO FUKTSIONAL'NYE KHARAKTERISTIKI RECHNOGO ZOOBENTOSA V ZONE ANTROPOGENNYKH VOZDEISTVII).
Akademiya Nauk SSSR, Leningrad. Zoologicheskii Inst.
A. F. Alimov, and V. A. Teslenko.
Gidrobiologicheskii Zhurnal GBZUAM, Vol 24, No 2, p 27-31, 1988. 2 fig, 3 tab, 3 ref. English summary.

Descriptors: *USSR, *Water pollution effects, *Rudnaya River, *Benthos, *Species diversity, *Izhora River, Self-purification, Rivers.

The structure of benthic communities was examined to determine their production in the Rudnaya River flowing from the eastern slope of the Sikhote-Alin Range towards the Sea of Japan. Structural and functional characteristics of the Rudnaya River and the Izhora River (Leningrad Region) are shown to be changed. An equation was developed to relate the Woodiwiss index relation to the index of diversity. The role of benthic invertebrates in the self-purification processes of the river was estimated in a first approximation from values of energy flows. The previously established relationship between the indices of structure and functioning of benthic communities has been confirmed. (Author's abstract)
W89-12280

HETEROTROPHIC NANO--AND MICROPLANKTON IN REGIONS OF LARGE HARBOR TOWNS (GETEROTROFNYI NANO-- I MIKROPLANKTON V RAIONAKH KRUPNYKH MORSKIKH PORTOVYKH GORODOV).
Akademiya Nauk SSSR, Moscow. Inst. Okeanologii.
A. I. Kopylov, and A. F. Sazhin.
Okeanologiya ONLGAE, Vol 28, No 3, p 472-477, June 1988. 3 tab, 17 ref. English summary.

Descriptors: *Water pollution effects, *Bays, *Plankton, *Coastal waters, Biomass, Decomposition, Self-purification.

The level of development of heterotrophic nano- and microplankton in different harbor bays experiencing significant anthropogenic influences was investigated. The quantitative composition of heterotrophic organisms, data on the relationship of the amount and biomass of the organisms, the decomposition, and the reproduction rate of nano-and microplankton are presented. The role of these organisms in the process of self-purification of coastal waters is discussed. (Peters-PTT)
W89-12284

ZOOBENTHOS OF THE RIVER VIT. II. DYNAMICS OF THE BENTHIC ZOOCOENOSES UNDER ANTHROPOGENIC INFLUENCE (ZOOBENTOST NA R. VIT. II. IZMENENIE NA ZOOBENTOSNITE ZOOTSENOZI POD ANTROPOGENNO VLIIANIE).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
I. J. Janeva.
Hydrobiologia HYDRB8, Vol 32, p 3-30, 1988. 7 fig, 13 tab, 5 ref. English summary.

Descriptors: *USSR, *Water pollution effects, *Vit River, *Low flow, *Benthic fauna, *Pollution index, Insects, Midges, Oligochaetes, Dissolved oxygen, Biological oxygen demand, Mussels, Snails, Mollusks, Self-purification.

Changes in the ecological situation of the Vit River during 1973-1974 and 1978 are reported for separate benthic species and groups. The results of the studies have shown the extremely poor situation of the river during low flow with respect to its saprobiological state. At high water levels, the abilities for self-purification are demonstrated and maintained and the river quality is improved. At low water levels, however, the self-purification processes are strongly hindered. The established ecological parameters of the various benthic organisms under the conditions in the Vit River during the periods of the study show various possibilities for bearing the progressive pollution of the water. The representatives of the order Ephemeroptera are more widely spread in the Vit River. Various species from that group inhabit all ecological niches of the river, including stretches with high values of BOD5. Snails and mussels prefer the middle flow of the river and the conditions of beta-mesosaproby. The representatives of the class Hirudinea, the family Chironomidae (order Diptera) and the class Oligochaeta posses considerably greater tolerance to the increased pollution with respect to the other benthic groups. The Chironomidae larvae are not so resistant as the other two groups, at stable beta-mesosaproby they occupy 40% of the total number, while in the more polluted parts of the river their share decreases to 5-10%. Leech develop on a large scale when the pollution of the river with organic substances is within the boundaries of the alpha-mesosaproby. The bristled worms are more eurybiontic--more than half of the 33 established species were found at quite varied values of the ecological parameters and at low values of the saprobity index. (Author's abstract)
W89-12286

TRENDS IN THE CHANGES OF THE SAPROBIOLOGICAL CONDITION OF THE RIVER BELI LOM AND STRUCTURAL CHARACTERISTICS OF ITS BENTHIC ZOOCOENOSES DURING THE 1982-1984 PERIOD (TENDENTSII V IZMENENIIATA NA SAPROBIOLOGICHNOTO S'STOIANIE NA R. BELI LOM I STRUKTURNA KHARAKTERISTIKA NA BENTOSNITE I ZOOTSENOZI PREZ 1982-1984 YA).
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
B. K. Rusev, I. J. Janeva, and R. B. Detcheva.
Hydrobiologia HYDRB8, Vol 32, p 31-43, June 1988. 2 fig, 4 tab, 6 ref. English summary.

Descriptors: *Water quality, *USSR, *Water pollution sources, *Beli Lom River, *Pollution index, Water pollution effects.

The Beli Lom River has been studied 8 times (at 14 stations along its flow) in various seasons of the 1982-1984 period. Structural parameters were used to characterize the state of the zoocoenoses; the saprobiological state was established by the method of saprobic valencies. The results show the comparatively polluted situation of the Beli Lom River. The section from the 'Beli Lom' reservoir near Razgrad is quite changeable, from alpha-meso to beta-mesosaproby (Saprobity Index (Sr) = 25.04-49.36); from Razgrad to the village of Pisanec, from poor alpha-mesosaproby to polysaproby (Sr = 24.29-10) and in single cases even to isosaproby. As a result, the structure of the established zoocoenoses is strongly deformed. Comparison with the condition of the Beli Lom River in the 1969-1970 period shows the considerably poorer situation of the river during the more recent study. This is evident both in the lower values of Sr in the two sections of the river and in the lack of any possibility for self-purification in the lower reaches of the river. (Author's abstract)
W89-12287

ECHO LOCATION OF CORIXIDS IN DEEP WATER IN AN ACID LOCH.
Institute of Terrestrial Ecology, Edinburgh (Scotland).
A. A. Lyle, and K. East.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 2, p 161-170, April 1989. 4 fig, 1 tab, 23 ref.

Descriptors: *Acid rain effects, *Lakes, *Water boatmen, *Aquatic insects, *Acid water, Fish populations, Echolocation, Corixids, Glaenocorisa, Arctocorisa, Loch Grannoch, Scotland, Deep water, Population density, Ecological distribution.

Echo soundings in acid lochs in SW Scotland recorded numerous 'echoes' in the deeper, open water regions of lochs with depleted fish populations. Further investigations at Loch Grannoch showed that these echoes were produced by the corixid species Glaenocorisa propinqua and Arctocorisa germari. Their occurrences in large numbers is probably because of acidification and declining

fish predation. Some ecological aspects of their behavior and distribution in the loch are discussed. (Author's abstract)
W89-12288

GROWTH CHARACTERISTICS OF WATER LETTUCE (PISTIA STRATIOTES L.) IN SOUTH-WEST NIGERIA.
Ibadan Univ. (Nigeria). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W89-12293

FORMATION AND PERSISTENCE OF BENZO(A)PYRENE-DIOLEPOXIDE-DNA ADDUCTS IN LIVER OF ENGLISH SOLE (PAROPHRYS VETULUS).
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
U. Varanasi, W. L. Reichert, B. L. Eberhart, and J. E. Stein.
Chemico Biological Interactions CBINA8, Vol. 69, No. 2-3, p 203-216, 1989. 4 fig, 1 tab, 29 ref. Department of Health and Human Services Interagency Agreement No. Y01-CP-40507.

Descriptors: *Liver, *Nucleic acids, *Polycyclic aromatic hydrocarbons, *Carcinogens, *Water pollution effects, *Fish, Benzo(a)pyrene, Parophrys, Liver neoplasms, Pollutants, Puget sound, Tissue analysis.

The formation of DNA adducts from the carcinogenic environmental pollutant benzo(a)pyrene (BaP) was investigated in liver of English sole, a species that exhibits a high prevalence of liver neoplasms in several polycyclic aromatic hydrocarbon (PAH)-contaminated areas of Puget Sound, WA. Analysis by P32-postlabeling assay of hepatic DNA digests from fish exposed parenterally to BaP showed the presence of BaP-diol epoxide (BaPDE)-DNA adducts. When fish were injected with 2-15 mg BaP/kg body weight, one major adduct was detected and was identified as the anti-BaPDE-DNA adduct. In fish sampled at 1, 28 and 60 days post-exposure to 15 mg BaP/kg body weight, there was no significant change in the level of the anti-BaPDE-DNA adduct. The autoradiographs of P32-labeled hepatic DNA digests from fish exposed to 100 mg BaP/kg body weight showed an elongated spot suggesting the presence of more than one adduct. Chromatography on large polyethylenimine sheets showed 2 spots with the same chromatographic characteristics as those of syn-and anti-BaPDE-deoxyguanosine adduct standards. Mild acid hydrolysis of hepatic DNA from fish exposed from 100 mg BaP/kg body weight, also revealed the presence of tetrols derived from both anti-and syn-BaPDE, thus confirming the presence of syn-and anti-BaPDE. In fish exposed to 2-100 mg BaP/kg body weight, a linear (0.996) dose response for anti-BaPDE-DNA adduct formation was observed. The results offer the first direct evidence for the formation of the suspected ultimate carcinogen, BaPDE, in liver of fish exposed to BaP in vivo and thus further support the hypothesis that exposure to PAHs is an important factor in the etiology of hepatic neoplasms in English sole from contaminated sites. (Author's abstract)
W89-12295

EFFECTS OF OZONE AND WATER STRESS ON CANOPY TEMPERATURE, WATER USE, AND WATER USE EFFICIENCY OF ALFALFA.
California Univ., Riverside. Statewide Air Pollution Research Center.
For primary bibliographic entry see Field 2I.
W89-12348

TOXIC IMPACT OF FENVALERATE ON SUPEROXIDE DISMUTASE AND CATALASE ACTIVITY LEVELS IN LIVER, MUSCLE, AND GILL TISSUES OF A FRESHWATER FISH, TILAPIA MOASSAMBICA (PETERS).
Sri Venkateswara Univ., Tirupati (India). Dept. of Biochemistry.
V. Radhaiah, and S. Vijaya Kumar Reddy.
Biochemistry International BIINDF, Vol. 18, No. 3, p 655-660, March 1989. 2 tab, 10 ref.

Descriptors: *Water pollution effects, *Population exposure, *Toxicity, *Enzymes, *Fish physiology, *Insecticides, Organic pesticides, Fenvalerate, Oxygen deficit, Respiration, Biochemistry, Absorption, Organic compounds.

Superoxide dismutase (SOD) and catalase enzymes are considered to be indispensable for the survival of aerobic organisms, protecting the cells from the deleterious effects of active oxygen forms such as superoxide radicals and hydrogen peroxide. Fenvalerate, apart from its insecticidal activity, is reported to be toxic to many aquatic organisms; there is little known of the toxicity of fenvalerate on oxygen metabolizing enzymes in freshwater fish. The activity levels of SOD and catalase were examined in the liver, muscle and gill tissues of control and fenvalerate-intoxicated freshwater fish, Tilapia mossambica. Cyanide-sensitive SOD activity was decreased significantly, compared to controls, in gill, muscle and live tissues of fenvalerate-exposed fish. Catalase activity was decreased in the order of gill > liver > muscle in fenvalerate-intoxicated fish. Results suggest a significant threat to the fish from severely compromised oxygen utilization under fenvalerate toxicity. (Friedmann-PTT)
W89-12356

DISTRIBUTION OF POLYCHLORINATED BIPHENYL CONGENERS AND OTHER HALOCARBONS IN WHOLE FISH AND MUSCLE AMONG LAKE ONTARIO SALMONIDS.
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W89-12383

CHANGES IN THE CHEMISTRY OF SURFACE WATERS: 25-YEAR RESULTS OF THE HUBBARD BROOK EXPERIMENTAL FOREST, NH.
Syracuse Univ., NY.
For primary bibliographic entry see Field 2K.
W89-12385

ECONOMIC EFFECTS OF SALINITY AND DRAINAGE PROBLEMS.
Rhode Island Univ., Kingston. Dept. of Resource Economics.
For primary bibliographic entry see Field 3C.
W89-12420

BIOLOGICAL CONSEQUENCES OF SELENIUM IN AQUATIC ECOSYSTEMS.
California Univ., Davis. Dept. of Land, Air and Water Resources.
E. A. Davis, K. J. Maier, and A. W. Knight.
California Agriculture CAGRA3, Vol. 42, No. 1, p 18-20, 29, January-February 1988. 1 fig, 2 tab. USGS Grant 14-08-0001-G1495; University of California Salinity and Drainage Task Force Grant 86-9; Water Resources Center of the University of California Grant UCAL-WRC-W-669.

Descriptors: *California, *Path of pollutants, *Selenium, *Water pollution effects, *Toxicity, Aquatic environment, Chemistry, Bioaccumulation, Food chains, Mineralization, Metabolism, Fish, Sediments, Algae, Reviews, Invertebrates.

The chemistry, occurrence, and toxicity of selenium in the aquatic environment are reviewed. At low concentrations, selenium is a micronutrient for many aquatic organisms. At higher concentrations, selenium toxicity is mediated by its ability to combine with proteins. Organisms complete the selenium cycle by returning organic selenium to the environment through methylation and mineralization. Methylated selenium compounds are volatile and relatively insoluble, and are easily lost to the atmosphere. Little is known about the organisms, rates, or pathways involved in selenium mineralization. Organic forms of selenium are approximately ten times more toxic than inorganic forms to aquatic algae, invertebrates, and fish. The reduced ability to reproduce is a toxic effect of selenium found at all levels of the food chain. Bioaccumulation of selenium can be accomplished by either bioconcentration or biomagnification; the latter has yet to be substantiated by laboratory experiments. Numerous possibilities for dealing with excess selenium are under investigation, including oceanic or estuarine disposal. More knowledge of the selenium cycle is essential to planning the best time, place, and method for such a solution. (Doria-PTT)
W89-12421

EFFECT OF FENVALERATE ON METABOLIC ION DYNAMICS IN THE FATHEAD MINNOW (PIMEPHALES PROMELAS) AND BLUEGILL (LEPOMIS MACROCHIRUS).
Iowa State Univ., Ames. Dept. of Entomology.
D. M. Symonik, J. R. Coats, S. P. Bradbury, G. J. Atchison, and J. M. Clark.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 6, p 821-828, June 1989. 3 tab, 15 ref. US EPA Grant 810659-02-0.

Descriptors: *Fathead minnows, *Water pollution effects, *Fenvalerate, *Pesticide toxicity, *Metabolism, *Ions, *Bluegills, *Fish physiology, Dynamics, Insecticides, Fish, Tissue analysis, Bioaccumulation, Sodium, Calcium, Chlorides, Absorption, Statistical analysis.

The uptake and depuration of sodium, calcium, and chloride ions were monitored in bluegill and fathead minnows exposed to the synthetic pyrethroid insecticide fenvalerate. There was a trend towards increased sodium uptake in bluegills and minnows with exposure to fenvalerate. No statistical differences were found in depuration rate for bluegill, although minnows did exhibit a higher depuration rate at 8 h postexposure. Minnows seemed to accumulate more Cl36 than the bluegill on a per gram body weight basis. There were no significant differences between control and exposed fish for bluegill. Means for both bluegills and minnows would seem to indicate a reduction in uptake with increasing exposure to fenvalerate. There was no statistical difference between control and fenvalerate-exposed minnows when both uptake and depuration for Ca45 are compared. Fenvalerate exposure caused significant increase in calcium uptake in bluegill, and a lower depuration rate at 3 h postexposure. The large variability in these results makes trends difficult to characterize. It is concluded that the whole-body ion method employed was not adequate to document these effects quantitatively. (Doria-PTT)
W89-12443

IN VIVO EFFECTS OF CADMIUM CHLORIDE ON CERTAIN ASPECTS OF CARBOHYDRATE METABOLISM IN THE TISSUES OF A FRESHWATER FIELD CRAB BARYTELPHUSA GUERINI.
Osmania Univ., Hyderabad (India). Dept. of Zoology.
S. L. N. Reddy, N. B. R. K. Venugopal, and J. V. R. Ramana Rao.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 6, p 847-853, June 1989. 3 tab, 19 ref.

Descriptors: *Cadmium, *Metabolism, *Carbohydrates, *Water pollution effects, *Crabs, *Toxicity, Chlorides, Crustaceans, Heavy metals, Animal physiology, Tissue analysis, Enzymes, Hyderabad.

The present study reports the influence of cadmium on certain aspects of carbohydrate metabolism in the tissues of the freshwater field crab Barytelphusa guerini, exposed to sublethal concentration of cadmium chloride. The effect of cadmium chloride on glycogen, total free sugars, glycogen phosphorylase, succinate dehydrogenase (SDH), lactate dehydrogenase (LDH), and lactate levels in the tissues, gill, leg muscle, hepatopancreas, heart, and thoracic ganglion was investigated. The results reveal that the carbohydrate metabolism was significantly altered during sublethal toxicosis of cadmium chloride. The alterations were found to be tissue-specific and time-dependent. Inhibition of SDH activity in the crab suggests the dependence of crab on glycolytic metabolism for energy needs. The sensitivity of LDH can be taken as a meaning-

ful biochemical index during CdCl2 toxicosis. Isozymal characterization of this enzyme at regular intervals of chronic exposures could present a meaningful picture about the tissue-specific dependence for energy requirements during this toxicity. (Doria-PTT)
W89-12446

EFFECT OF HEAVY METALS IONS ON ENZYME ACTIVITY IN THE MEDITERRANEAN MUSSEL, DONAX TRUNCULUS.
Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Life Sciences.
L. Mizrahi, and Y. Achituv.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 6, p 854-859, June 1989. 1 tab, 21 ref.

Descriptors: *Mediterranean Sea, *Heavy metals, *Enzymes, *Toxicity, *Metabolism, *Mollusks, *Water pollution effects, Animal physiology, Israel, Cations, Cadmium, Mercury, Lead, Copper, Zinc.

The aim of the present study was to examine the effects of different concentrations of each of five heavy metal ions on the activity of four enzymes in Donax trunculus, lactate and malate dehydrogenase, cytochrome oxidase, and alpha-amylase. Results demonstrate a wide variation in the acute toxicities of different metals. Enzymes were affected differently in the presence of the ions studied. Alpha-amylase, an important digestive enzyme of bivalves, was only slightly affected by any ion. The other enzymes tested were more sensitive to heavy metals ions. At the test concentrations of 0.05 and 0.1 ppm, most of the metals tested did not influence the enzymes studied. The only metal ion that caused an effect at 0.1 ppm was Cd, which slightly inhibited the activity of cytochrome oxidase and lactate dehydrogenase. Cd and Hg were found to be high inhibitors of lactate dehydrogenase and cytochrome oxidase of Donax at 1 and 10 ppm. With Pb and Cu, even at the high concentrations, there was only a slight inhibition in the activity of these two respiratory enzymes. About 50% of the activity of cytochrome oxidase was inhibited by 10 ppm Zn, and it was hardly effective on the lactate hydrogenase. (Doria-PTT)
W89-12447

ORGANOCHLORINE INSECTICIDE RESIDUES IN FISH AND BIRDS FROM THREE RIVER SYSTEMS ON THE NORTH COAST REGION OF NEW SOUTH WALES.
North Coast Agricultural Inst., Wollongong (Australia).
For primary bibliographic entry see Field 5B.
W89-12449

ACUTE AND SUB-ACUTE TOXICITY OF BARK TANNINS IN CARP (CYPRINUS CARPIO L).
Agricultural Univ., Wageningen (Netherlands). Dept. of Toxicology.
J. H. M. Temmink, J. A. Field, J. C. vanHaastrecht, and R. C. M. Merkelbach.
Water Research WATRAG, Vol. 23, No. 3, p 341-344, March 1989. 7 fig, 1 tab, 13 ref.

Descriptors: *Sublethal effects, *Tannins, *Pulp wastes, *Water pollution effects, *Toxicity, *Lethal limit, *Tannins, *Carp, Chemical oxygen demand, Flow system, Polymers, Oxidation process, Gills, Tissue analysis, Animal pathology.

The 24-hour LC(I)50 (lethal concentration for 50% of the test population during initial testing) and 96-hour LC(I)50 of bark extract for carp (Cyprinus carpio) were estimated at approximately 65 and 50 milligrams per liter total chemical oxygen demand (COD), in a semi-static system. Tannins, constituting 50-60% of total COD, are responsible for this toxicity. Considerable toxicity was also found in sub-acute studies in a flow-through system. In both systems oxidative polymerization of the tannins into high-molecular-weight polymers abolished the aquatic toxicity almost completely. Epithelial damage of the gill was the most important lesion of toxicity, supporting the hypothesis that the toxic action of oligomeric bark tannins is through binding to and cross-linking of cell-membrane enzymes. (Author's abstract)
W89-12487

HEALTH EFFECTS ASSOCIATED WITH WASTEWATER TREATMENT, DISPOSAL, AND REUSE.
Alberta Univ., Edmonton. Div. of Health Services Administration.
S. E. Hrudey, and E. J. Hrudey.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 849-854, June 1989. 111 ref.

Descriptors: *Literature review, *Human diseases, *Human pathology, *Wastewater disposal, *Wastewater renovation, *Water reuse, *Wastewater treatment, Pathogens, Safety, Hazardous materials, Giardia, Diseases, Dioxin, Polychlorinated biphenols, Bacteria, Viruses.

Current studies on the health effects associated with wastewater treatment, disposal, and reuse are reviewed. Identified health and safety concerns were summarized as hepatitus A, other viral infections, leptospirosis, parasite infestation and general gastrointestinal illness. Safety needs for wastewater collection and treatment personnel in the United States, Finland and Italy were also reviewed. In the area of sludge handling and disposal the practicality of formulating guidelines to assess the risks associated with exposure to pathogens in sludge was assessed. Other aspects reviewed include excreta or wastewater disposal, wastewater reuse, contamination of water supplies, municipal solid waste disposal, and industrial and hazardous wastes; and the health problems such as diarrhea, enteric disease, Giardia transmission, guinea worm disease, vascular 'Blackfoot Disease,' dioxin and PCB exposure, and other toxic substance exposure associated with health problems. (White-Reimer-PTT)
W89-12519

COAL AND COAL MINE DRAINAGE.
Olem Associates, Washington, DC.
H. Olem.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 879-882, June 1989. 60 ref.

Descriptors: *Water pollution effects, *Wastewater treatment, *Literature review, *Coal mining, *Mine wastes, *Acid mine drainage, Control systems, Regulations, Land reclamation, Oxidation, Characterization, Mine waste treatment, Neutralization, Path of pollutants.

The origin and influence of coal mine drainage on streams, control and treatment of acid mine drainage, and books and proceedings dealing with coal mines and coal mine drainage are reviewed. Environmental regulations include a proposal to amend regulations designed to protect alluvial valley floors, amended regulations to allow the U.S. Office of Surface Mining Reclamation and Enforcement to use money collected from the payment of civil penalties to reclaim lands that have been mined, abandoned, or left inadequately reclaimed, and rules governing roads at surface and underground mining operations and coal exploration areas. Characterization of coal mine wastes include regional, chemical, and biological characterization. Case studies for mine waste treatment and control dealt with neutralization, high density sludge processes, manmade wetlands, rock filled columns used in a submerged upflow manner to oxidize and remove dissolved manganese, and natural wetlands. Models have also been developed to track the seasonal fate and mass transport of sulfate and alkalinity along a lake, and to demonstrate the importance of sulfate reduction and the effects of pH reduction and increased Al and Zn on natural systems. (White-Reimer-PTT)
W89-12527

NONPOINT SOURCES.
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W89-12533

DISSOLVED OXYGEN IN STEAMS AND RESERVOIRS.
Tennessee Valley Authority, Chattanooga.
W. L. Poppe.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 953-954, June 1989. 32 ref.

Descriptors: *Literature review, *Dissolved oxygen, *Stream pollution, *Reservoirs, Model studies, Aeration, Destratification, Phytoplankton, Monitoring, Eutrophication.

A review of recent research on dissolved oxygen in streams and reservoirs includes studies on: (1) Water quality in streams and reservoirs; (2) Water quality models such as a one-dimensional dynamic riverine model for a dam study, and reservoir models; (3) Gas transfer studies on the oxygen injection method to restore the level of DO in a river, the effects of artificial aeration on phytoplankton communities, and destratification to restore eutrophic lakes; and (4) Aquatic effects and monitoring using an in situ benthic chamber to measure respiration and photosynthesis in rivers, and oxygen sensitive microelectrodes. (White-Reimer-PTT)
W89-12536

THERMAL EFFECTS.
Federated Dept. Stores and Allied Stores Corporation, 7 West Seventh Street, Cincinnati, OH 45202.
J. B. Cravens, and J. Hudson.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 984-991, June 1989. 69 ref.

Descriptors: *Water pollution effects, *Literature review, *Thermal pollution, *Thermal stress, *Temperature effects, *Animal physiology, *Plant physiology, Environmental effects, Toxicity, Model studies, Animal behavior, Fish behavior, Growth, Metabolism, Reproduction.

Recent research concerning the environmental effects of thermal discharges and changes is reviewed. Topics discussed include: (1) Review articles and model studies that simulate variations in temperature as a result of thermal discharges; (2) The effects of thermal changes on the survival, growth, and photosynthesis of producers; (3) Changes in reproduction, larvae, and embryos of consumer species; (4) Activity changes as a result of the relationship between temperature and metabolism; (5) Changes in distribution patterns; (5) The effects of temperature on feeding and growth; (6) Oxygen metabolism; (7) Thermal tolerance, preference and stress reactions of various organisms; (8) The effects of temperature on biochemical reactions by measuring parameters such as immobilization, paralysis, mortality, metabolic rate, cardiac output, blood flow distribution, regional perfusion, and phospholipid concentration. (White-Reimer-PTT)
W89-12538

EFFECTS OF POLLUTION ON FRESHWATER ORGANISMS.
Environmental Monitoring Systems Lab., Cincinnati, OH. Aquatic Biology Branch.
Q. Pickering, D. O. Carle, A. Pilli, T. Willingham, and J. M. Lazorchak.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 998-1042, June 1989. 3 tab, 422 ref.

Descriptors: *Literature review, *Water pollution effects, *Aquatic animals, *Aquatic plants, *Fish, *Invertebrates, *Algae, *Duckweed, *Bioassay, Bioconcentration, Toxicity, Field tests.

An annual review summarizes the literature published on the effects of pollutants on freshwater fish, invertebrates, algae, and duckweed is presented. The following criteria were used in the selection of literature for the review: pollutants includ-

ing toxic chemicals and oil; effect types were defined as acute, sublethal, and bioconcentration; and tests conducted in the field and in the laboratory were covered. The data are presented in tables organized by organism, test endpoint and duration; and summaries of data reported in the literature for broad categories of pollutants or for single toxicant tests in which standard acute or sublethal endpoints were not available. Applicable articles were obtained from four abstracting journals, 60 toxicity related journal publications, the EPA publication bibliography and the EPA Environmental Research Laboratory-Duluth and Environmental Monitoring Systems Laboratory-Cincinnati reprint collection. (White-Reimer-PTT)
W89-12540

EFFECTS ON SALTWATER ORGANISMS.
California State Univ., Long Beach. Dept. of Biology.
D. J. Reish, P. S. Oshida, A. J. Mearns, and T. C. Ginn.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 1042-1054, June 1989. 2 tab, 158 ref.

Descriptors: *Literature review, *Marine environment, *Marine animals, *Water pollution effects, *Marine pollution, *Marine plants, Oil pollution, Sediment contamination, Toxicity, Organotins, Plastic debris, Outfalls, Aquaculture, Model studies, Toxicity, Heavy metals, Pesticides.

A review of recent literature on the effects of pollution on saltwater organisms includes: (1) Residues and related topics; (2) Sediment toxicity for selected contaminants to polychaetes, oligochaetes, lancelets, amphipods, and other invertebrates; (3) Surveys to define pollution gradients, use of multivariate techniques, and long-term monitoring programs; (4) Organotins; (5) Extent of and effects of plastic litter and debris on biota; (6) Ecological effects of oil pollution; (7) Surveys of outfalls and disposal sites; (8) Aquaculture impacts; (9) Cytogenetic and pathological studies dealing with sister-chromatid exchanges and effects of a sludge dumpsite on haddock; (10) Population and community models for periphyton communities and fish populations; (11) Toxicity of metals, polynuclear aromatic hydrocarbons, pesticides, herbicides, and bleached kraft mill effluent. (White-Reimer-PTT)
W89-12541

HUMAN HEALTH EFFECTS ASSAYS.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
L. Fradkin, C. Sonich-Mullin, M. Cerny, C. Kruger, and F. Cavender.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 1072-1077, June 1989. 2 tab, 74 ref.

Descriptors: *Literature review, *Bioassay, *Toxicity, *Human diseases, *Human pathology, *Drinking water, *Water pollution effects, Risks, Human studies, Animal studies, Fish bioassays, Animal behavior, Testing procedures, Municipal wastewater, Sewage sludge, Industrial wastes.

The use of assays to evaluate and assist in predicting potentially adverse human health effects associated with exposure to pollutants in water (that is, municipal wastewater, sewage sludge, ambient water, and drinking water) is the focus of this review. Estimation of human health effects associated with exposure to pollutants in water was determined by epidemiologic studies, acute and chronic animal studies, toxicity studies, mutagenicity studies, and in vitro toxicity studies. Epidemiologic studies were used to estimate the human health risks including cancer associated with domestic consumption of, or exposure to, chlorinated water, unchlorinated water, groundwater supplies containing radon and its progeny, drinking water containing trichloroethylene or radon, and hardness components of sewage. Several animal bioassays have been performed on contaminants in water. In some cases, whole, extracted, or separated wastes were given to animals; in other studies, 'contaminants' were administered as pure chemicals. Fish bioassays provide a possible means of monitoring aquatic contamination and estimating toxicity. Changes in the behavior of aquatic animals provided information on the potential toxicity of contaminated water. A variety of microbial and in vitro assays have been used to estimate water quality and to provide information regarding the potential hazard associated with exposure to contaminated water and/or its wastes. A summary of short-term bioassays used to assess the genotoxicity of samples from drinking water, wastewater, and river water contaminated with industrial products is presented in table form. (White-Reimer-PTT)
W89-12544

EFFECTS OF CHEMICALS ON MICROORGANISMS.
Environmental Protection Agency, Washington, DC. Office of Toxic Substances.
J. D. Walker.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 1077-1097, June 1989. 1 tab, 96 ref.

Descriptors: *Literature review, *Water pollution effects, *Microorganisms, *Toxicity, *Bioassay, Bacterial physiology, Algal physiology, Photosynthesis, Respiration, Fungi, Yeasts, Testing procedures, Biotechnology, Aquatic environment, Sediments, Soil environment, Wastewater.

Recent studies on the effects of chemicals on microorganisms are reviewed. A table shows chemicals tested, EC50, and the test used. Topics discussed include: (1) Bacterial toxicity tests that measured bioluminescence, respiration, growth, enzyme activity, and methanogenesis; (2) Algal toxicity tests for photosynthetic response, growth, density, nitrogen fixation, and glycophosphate; (3) Fungal and yeast toxicity tests; (4) Comparative sensitivity of microbial toxicity testing systems by measuring growth, oxygen uptake, dehydrogenase and alkaline phosphatase activity, photosynthesis, respiration, nitrogenase, nitrate reductase, and glutamine synthetase in bacteria and algae; (5) Comparative sensitivity of microbial, terrestrial, and aquatic organism testing; (6) Quantitative structure activity relationships; (7) Use of microbes to assess toxicity in different environments such as water, sediment, soil, and wastewater; and (8) biotechnology. (White-Reimer-PTT)
W89-12545

ACIDIC DEPOSITION.
Connecticut Univ., Storrs. Dept. of Civil Engineering.
N. P. Nikolaidis, V. S. Nikolaidis, and H. Olem.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 1109-1117, June 1989. 147 ref.

Descriptors: *Water pollution sources, *Literature review, *Acid rain, *Acid streams, *Acidic soils, *Acidic water, Model studies, Regional assessments, Transport, *Water pollution effects, Hydrogen ion concentration, Liming, Alkalinity, Heavy metals, United States, Europe, Neutralization.

A review of recent research, conferences, and symposia dealing with acid deposition is presented. Topics covered include: (1) Regional assessments from Virginia, Massachusetts, national EPA assessments, eastern mountain regions, Florida, and parts of Canada and Europe; (2) Atmospheric deposition and transport studies on precipitation from Samoa, Bermuda, North America, Europe, Greece, the Netherlands, and statistical methods for analyzing temporal variations and distribution patterns; (3) Effects of deposition on pH of soils, chemical interactions, nitrification, SO4(-2), metals uptake, eutrophication, and groundwater; (4) Model studies to simulate past and future conditions and predict effects; and (5) The effects and techniques of liming acidic waters citing existing programs in Sweden and other areas, and models to compute the final alkalinity of waters neutralized by sodium or calcium-based materials and liming terrestrial systems for surface water neutralization. (White-Reimer-PTT)
W89-12547

BIOMONITORING.
Eckenfelder, Inc., Nashville, TN.
For primary bibliographic entry see Field 5A.
W89-12548

COLONIZATION, VARIABILITY, AND THE USE OF SUBSTRATUM-FILLED TRAYS FOR BIOMONITORING BENTHIC COMMUNITIES.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
W. H. Clements, J. H. Van Hassel, D. S. Cherry, and J. Cairns.
Hydrobiologia HYDRB8, Vol. 173, No. 1, p 45-53, March 15, 1989. 3 fig, 3 tab, 17 ref.

Descriptors: *Water pollution effects, *Thermal pollution, *Virginia, *Bioindicators, *Monitoring, *Rivers, *Macroinvertebrates, Artificial substrates, Aquatic habitats, Adair Run, New River, Clinch River, Electric powerplants, Performance evaluation, Powerplants.

Sampling variability and colonization rate of introduced substrates (plastic trays filled with pebble and cobble) in two southwestern Virginia streams (Adair Run, a tributary to the New River, and Clinch River) are described. Substrates were colonized rapidly by aquatic macroinvertebrates, but colonization rates differed between years, possibly due to annual variability in macroinvertebrate abundance. To examine the applicability of using these substrates for biomonitoring benthic communities, trays were placed at several locations in the Clinch River, which was receiving power plant discharges. Only six samples were necessary to detect a 15% reduction in macroinvertebrate density and a 12% reduction in number of taxa at effluent sites. Benthic communities established on rock-filled trays and multiplate samples collected from the same stations during the same period were compared. Although multiplate sampler results were more variable than those from rock trays and were selective for different taxa, both substrate types showed significant differences in community parameters among locations. Rock trays at all sites were dominated by Cheumatopsyche sp., whereas chironomids were more abundant on multiplate samplers. The relative abundance of mayflies was reduced at the effluent site on both substrate types. (Author's abstract)
W89-12572

PHOSPHORUS AS A GROWTH-REGULATING FACTOR RELATIVE TO OTHER ENVIRONMENTAL FACTORS IN CULTURED ALGAE.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W89-12584

PHYTOPLANKTON BIOMASS AND PRODUCTION IN RELATION TO PHOSPHORUS.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
U. Heyman, and A. Lundgren.
Hydrobiologia HYDRB8, Vol. 170, p 211-227, December 1988. 5 fig, 102 ref.

Descriptors: *Limnology, *Phosphorus, *Eutrophication, *Primary productivity, *Phytoplankton, Biomass, Light, Temperature, Limiting nutrients, Lakes, Algae, Cycling nutrients, Chlorophyll, Zooplankton, Reviews.

Phosphorus-limited phytoplankton can respond to changes in P concentrations by a change in biomass and/or a change in rate of production. The light climate, as well as temperature and nutrients other than P, may also change the dynamics of the phytoplankton in a way that alters its response to P. Many data sets on phytoplankton biomass (measured as chlorophyll) and production are available and, together with culture experiments and more detailed studies on biovolumes and species composition, they may shed some light on these problems. The present understanding of the relationship between phytoplankton and P is inadequate, but some tentative conclusions can be

drawn. In most lakes phytoplankton biomass is determined mainly by the concentration of P, but growth also roughly follows a logistic density-dependent growth equation. Field studies that include estimates of primary production, biomass and environmental factors can be used to determine which factors that are of importance in determining the relation between growth and maximum growth. From studies of phytoplankton under low light conditions, it is clear that light is the main determinant of the growth rate, probably by decreasing the maximum growth rate. When the light climate is better, maximum growth rate is determined by temperature. Field studies indicate that (1) temperature and light, (2) rate of elimination, and (3) the species composition (or rather the strategy of the present species) determines the relation between biomass and carrying capacity. Temperature and light affect maximum growth rate, resulting in a change in the relationship between growth and maximum growth rate, which may result in a change in the relation between biomass (B) and carrying capacity (K). Both light and temperature affect the succession of species, which may in turn change B/K. In most studies the production per unit biomass is much higher than the actual change in biomass and elimination must therefore approximately equal production. Zooplankton grazing often accounts for most of the elimination. The mechanisms that determine which form of elimination is important are largely unknown, but nutrient concentration seems to be of major importance. (Rochester-PTT)
W89-12585

EFFECTS OF AN EXPERIMENTAL ACID PULSE ON INVERTEBRATES IN A HIGH ALTITUDE SIERRA NEVADA STREAM.
California Univ., Santa Barbara. Dept. of Biological Sciences.
P. S. Hopkins, K. W. Kratz, and S. D. Cooper.
Hydrobiologia HYDRB8, Vol. 171, No. 1, p 45-58, February 1, 1989. 5 fig, 1 tab, 55 ref. California Air Resources Board Grant CAL ARB A3096-32.

Descriptors: *Acid rain effects, *Bioindicators, *California, *Acidic water, *Invertebrates, *Water pollution effects, Animal behavior, Mountain streams, Sierra Nevada Mountains, Kaweah River, Aquatic insects, Aquatic drift.

The effects of pulsed acidification on invertebrate densities and drift, and water chemistry, in a high-altitude Sierra Nevada stream were measured using artificial stream channels. Water was diverted from the Marble Fork of the Kaweah River, Calfornia, through 12 replicate channels. However, low flow in the summer of 1985 eliminated all but four fo these channels. Channels were stocked with natural substrates and organisms from the Marble Fork of the Kaweah River. After a 3-wk acclimation period, a low-pH rain event was simulated by adding acid (H_2SO_4 and HNO_3) to two of the channels, reducing pH to 5.0 for 6 hr. The other two channels acted as controls (pH 6.4). During acid additions, Baetis spp. drift in acidified channels was about 7 times higher than in control channels ($F = 39.02$, $p < 0.025$; data fourth route transformed, analysis of variance), and the percentage of drifting baetids that were dead was significantly higher in acidified than control channels (46% vs. 0%, $F = 29.86$, $p < 0.0$; arcsine square root transformed data, analysis of variance). Other taxa showed no significant drift responses, and benthic densities of all taxa showed no effects two days after acidification, probably owing to rapid recolonization by invertebrate drift in influent waters. Metal concentrations did not significantly increase in the 2-m stream channels. The present results suggest that Baetis in particular may be a good 'early-warning' indicator of the effects of acid deposition on Sierra Nevada streams. (Author's abstract)
W89-12595

EVIDENCE OF STRUCTURAL AND FUNCTIONAL ADAPTATION IN EPILITHON EXPOSED TO ZINC.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
F. S. Colwell, S. G. Hornor, and D. S. Cherry.
Hydrobiologia HYDRB8, Vol. 171, No. 1, p 79-90, February 1, 1989. 3 fig, 3 tab, 38 ref.

Descriptors: *Heavy metals, *Epilithon, *Water pollution effects, *Zinc, Artificial water courses, Metabolism, Respiration, Primary productivity, Biomass, Microorganisms, Succession.

Artificial streams were used to study the effect of chronic zinc dosing (0.00, 0.05, or 1.00 mg Zn/L) on epilithic communities during summer and early fall, 1984 and 1985. Following zinc addition, epilithon was periodically measured for 14C-glucose and 14C-glutamate respiration, ash-free dry weight (AFDW), protein, carbohydrate, chlorophyll a (Chl a), pheophytin a (pheo a), and colony-forming units (CFU) on zinc-amended and unamended media. Transient peaks in glucose respiration rates/mg protein AFDW occurred within 5 to 10 days in streams dosed with 1.0 mg Zn/L and coincided with decreases in AFDW, protein, carbohydrate, Chl a, and pheo a. Respiration of glutamate did not show a significant response to dosing (alpha = 0.05). Epilithic plate counts demonstrated more total and zinc-tolerant CFU in dosed than in control epilithon after 20 days. After 30 days, greater biomass and lower protein:carbohydrate ratios were evident in epilithon dosed with 1.0 mg Zn/L compared to unamended treatments. Peaks in glucose respiration suggested the presence of zinc-tolerant heterotrophs transiently capable of increased respiration of glucose but not glutamate. Concurrently, minimal but measurable biomass implied the persistence of zinc-tolerant microorganisms in the zinc-dosed epilithon. By the end of the studies, the results indicated that metal-tolerant populations replaced metal-sensitive organisms under conditions of elevated zinc concentration. These zinc-adapted communities had lower potential value as a food source to grazers (low protein:carbohydrate ratio) and were no longer distinctive with respect to glucose respiration. (Author's abstract)
W89-12597

IMMUNOTOXICOLOGICAL EVALUATION OF TOLUENE EXPOSURE VIA DRINKING WATER IN MICE.
Utah State Univ., Logan. Dept. of Biology.
G. C. Hsieh, R. P. Sharma, and R. D. R. Parker.
Environmental Research ENVRAL, Vol. 49, No. 1, p 93-103, June 1989. 1 fig, 5 tab, 37 ref. USGS grant G-1255.

Descriptors: *Immunoassay, *Toluenes, *Toxicity, *Mice, *Drinking water, *Water pollution effects, Population exposure, Dose-response relationships, Biochemistry, Animal physiology, Animal tissues.

Toluene is a known contaminant found in trace amounts in groundwater. Male CD-1 mice were exposed to 0, 17, 80, and 405 mg/l toluene in drinking water for 4 wk. Immune function assays were selected to evaluate specific humoral and cell-mediated immunity, interleukin-2 (IL-2) activity, hematology, along with general toxicity. Toluene produced an increase in liver weight and decrease in thymus mass at the highest dose. No effects on body weights and hematological parameters, including erythrocytes, leukocytes, and their differentials were noticed. Mitogenesis by lipopolysaccharide, pokeweed mitogen, concanavalin A, and phytohemagglutinin were suppressed in splenocytes from treated mice. Splenocyte lymphoproliferation to alloantigens decreased at the 405 mg/l concentration only. Numbers of sheep red blood cell (SRBC)-specific plaque-forming cells decreased in the highest dosed animals; however, no significant change was observed in the serum alpha-SRBC antibody level. Toluene also adversely affected IL-2 synthesis at the 405 mg/l concentration. Findings suggest that alteration of immune functions of mice ingesting toluene was generally evident at relatively high doses, except for splenic lymphocyte responses to selected mitogens. (Author's abstract)
W89-12607

DEATH IN THE SEA: A FISHERMAN'S PERSPECTIVE.
Finnish Game and Fisheries Research Inst., Helsinki. Fisheries Div.
H. Lehtonen, M. Hilden, and A. Jarvinen.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 5, p 207-214, May 1989. 7 fig, 21 ref.

Descriptors: *Environmental effects, *Fish populations, *Fisheries, *Economic impact, *Commercial fishing, *Water pollution effects, Input-output analysis, Income, Fish migration, Titanium, Wastewater outfall, Heavy metals, Salmon, Gill nets, Smelt, Herring, Fish behavior, Fishing gear.

Numerous studies have demonstrated that environmental changes have an impact on fish communities. Changes in the fish communities do have an impact on local fisheries, but this impact is often difficult to measure using test fishing data or general fisheries statistics. Material for this study was collected over a 40-yr period by a fisherman who made daily detailed records of his fishing (e.g. gear used, catches, fish prices, and numerous other details). His data from the fishing area at the mouth of the river Kokemanenjoki are analyzed for changes in catches, catch per unit of effort (cpue), total value of catch, and revenue per unit of effort, with the basic hypothesis that a fisherman's fishing strategy is sensitive to the revenue per unit of effort, and that changes in the revenue per unit of effort will be among the first measurable variables, which reflect the changing conditions of commercial fishing in an area. The area under study became a recipient of industrial loading beginning in 1961 with discharges from a titanium dioxide plant. The fishing area was 6-10 km north of the effluent pipe. The plant discharges iron, free sulfuric acid, TiO_2, mud, and heavy metals such as Al, Mn, Zn, Cr, and Pb. Results showed that Salmon disappeared as an important species in the 1950s, while the catch per unit of effort in herring trap nets and the herring set gill nets increased until 1960. The catches of sea trout in whitefish set gill nets remained low until 1973 when both total catch and cpue started to increase, the latter even tenfold in 4 years. THe cpue of smelt gill nets began to increase around 1960 and increased until fishing was reduced in 1967. Reasons for the decline of the cpue in the trap net fishery are that the gear became so fouled that their efficiency decreased, or that the herring population declined locally because of poor recruitment. Also, avoidance reactions are likely in the area as fish are known to sense weak concentration gradients of TiO_2 effluent. Overall, it is shown that a combination of biological, economic and technological factors affect a fisherman's livelihood. (Friedmann-PTT)
W89-12643

TAR POLLUTION ON SAUDI ARABIAN GULF BEACHES.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
S. L. Coles, and N. Gunay.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 5, p 214-218, May 1989. 2 fig, 1 tab, 17 ref.

Descriptors: *Beach pollution, *Persian Gulf, *Beaches, *Shores, *Tar, *Saudi Arabia, *Oil spills, *Water pollution effects, Marine environment, Environmental quality, Surveys, Sampling.

The abundance of beach tar on Saudi Arabian Gulf beaches was surveyed over a 20 month period from May 1985 to October 1986. Tar abundance ranged up to ten times values previously reported for areas elsewhere in the Arabian Gulf and 100 times upper values reported for other world regions. Tar concentrations of greater than 10 kg/m of shoreline commonly occurred, while values in the 1-10 kg/m ranges were frequent. By comparison, beach tar concentrations reported for other areas have generally been in the g/m range. Beach tar abundances were highly variable in space and time, and the highest values obtained were more related to recent oil spills than to seasonal changes in prevailing oceanographic conditions. The importance of frequent and repetiive sampling to determine maximal beach tar abundances for an area is emphasized by these results. (Author's abstract)
W89-12644

TIME TRENDS OF CHEMICAL CONTAMINANT LEVELS IN CANADIAN ATLANTIC COD WITH SEVERAL BIOLOGICAL VARIABLES.
Department of Fisheries and Oceans, Halifax (Nova Scotia). Physical and Chemical Sciences Branch.
For primary bibliographic entry see Field 5B.
W89-12647

EFFECT OF COPPER ON THE ULTRASTRUCTURE OF TORPEDO MARMORATA NEURONS.
Concordia Univ., Loyola Campus, Montreal (Quebec). Dept. of Biology.
H. E. Enesco, F. A. Pisanti, and E. A. Totaro.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 5, p 232-235, May 1989. 1 fig, 2 tab, 19 ref.

Descriptors: *Tissue analysis, *Microscopic analysis, *Water pollution effects, *Sublethal effects, *Copper, *Fish physiology, Heavy metals, Trace elements, Animal tissues.

The effect of copper exposure on cell ultrastructure was examined in electric lobe neurons of Torpedo marmorata. Comparisons were made between animals collected from a site of known copper pollution in the Bay of Naples, animals exposed to 4 ppm copper for 60 days in the laboratory, and controls collected from an unpolluted area in the Mediterranean. Copper exposure produced a significant increase in vacuoles and in lipofuscin granules, a significant decrease in Golgi apparatus. Copper exposure produced mitochondrial swelling but no reduction in mitochondrial volume. These ultrastructural changes are characteristic of cellular stress. (Author's abstract)
W89-12648

GENETICALLY ENGINEERED ERWINIA CAROTOVORA IN AQUATIC MICROCOSMS: SURVIVAL AND EFFECTS ON FUNCTIONAL GROUPS OF INDIGENOUS BACTERIA.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
V. S. Scanferlato, D. R. Orvos, J. Cairns, and G. H. Lacy.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 6, p 1477-1482, June 1989. 6 fig, 31 ref. NSF grant BSR-8705445 and EPA grant R-813805-01-0.

Descriptors: *Aquatic environment, *Genetic pollution, *Ecological effects, *Water pollution effects, *Genetic engineering, *Erwinia, *Aquatic bacteria, Microbiological studies, Survival, Chromosomes, Growth chambers, Survival, Risk assessment.

The risk related to the release of genetically engineered microorganisms (GEMs) depends on their establishment in the environment. Therefore, the ability to predict the survival and colonization of GEMs within an ecosystem is a key element in assessing the risk of their release. The survival of genetically engineered Erwinia carotovora L-864, with a kanamycin resistance gene inserted in its chromosome, was monitored in the water and sediment of aquatic microcosms. The density of genetically engineered and wild-type E. carotovora strains declined at the same rate, falling in 32 days below the level of detection by viable counts. The impact of the addition of genetically engineered and wild-type strains on indigenous bacteria belonging to specific functional groups important in nutrient cycling was examined. For up to 16 days, the densities of total and proteolytic bacteria were significantly higher ($P < 0.05$) in microcosms inoculated with genetically engineered or wild-type E. carotovora, but by 32 days after inoculation, they had decreased to densities similar to those in control microcosms. Inoculation of genetically engineered or wild-type E. carotovora had no apparent effect on the density of amylolytic and pectolytic bacteria in water and sediment. Genetically engineered and wild-type E. carotovora did not have significantly different effects on the densities of specific functional groups of indigenous bacteria ($P < 0.05$). (Author's abstract)
W89-12655

INFLUENCE OF COPPER EXPOSURE ON PREDATOR-PREY INTERACTIONS IN AQUATIC INSECT COMMUNITIES.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
W. H. Clements, D. S. Cherry, and J. Cairns.
Freshwater Biology FWBLAB, Vol. 21, No. 3, p 483-488, June 1989. 1 fig, 1 tab, 29 ref.

Descriptors: *Water pollution effects, *Animal behavior, *Aquatic insects, *Toxicity, *Copper, *Aquatic populations, *Predation, Field tests, Stoneflies, Caddisflies, Benthic communities, Bioassay, Diets, Heavy metals, Species composition, Food chains.

The influence of chronic copper exposure on predator-prey interactions between stoneflies (Paragnetina media) and their invertebrate prey were examined. Macroinvertebrate communities were established on trays filled with pebble and small cobble substrate, placed in the New River in Virginia, and recovered after 30 days. Trays were then acclimated and placed in one of four treatment groups: control, no predators; control, with predators; dosed with copper, no predators; and dosed with copper, with predators, for fourteen days. Results showed that the vulnerability of two species of net-spinning caddis flies (Chimarra sp. and Hydropsyche morosa) to predation by the stonefly, P. media, was significantly greater in experimental streams dosed with copper (target concentration = 6 microg/L) than in control streams. The results of stomach analyses showed that Hydropsychidae was the major component of stonefly diets in experimental streams and that the number of Hydropsychidae per stonefly gut was significantly greater in dosed streams than controls. These findings may have important implications for field studies at sites moderately impacted by heavy metals. If predation pressure in such systems is increased then the structure of benthic communities may be indirectly affected by metals. Results of this type cannot be predicted using single species bioassays. Therefore, simple bioassay tests should be supplemented with more environmentally realistic procedures that account for species interactions. (White-Reimer-PTT)
W89-12684

EFFECTS OF TEMPERATURE, EXPOSURE TIME AND OTHER WATER PARAMETERS ON THE ACUTE TOXICITY OF ENDOSULFAN TO EUROPEAN EEL, ANGUILLA ANGUILLA.
Valencia Univ. (Spain). Dept. of Animal Physiology.
M. D. Ferrando, and E. Andreu-Moliner.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 24B, No. 3, p 219-224, June 1989. 2 fig, 1 tab, 21 ref. Dereccion General de Investigacion Cientifica y tecnica del Ministerio de Educacion y Ciencia, Spain grant n PS 87-0076.

Descriptors: *Water pollution effects, *Chlorinated hydrocarbons, *Insecticides, *Pesticides, *Toxicity, *Bioassay, *Endosulfan, *Eel, *Lethal limit, Testing procedures, Temperature effects, Population exposure, Median tolerance limit, Fish.

The results of toxicity tests conducted using the European eel Anguilla anguilla under three different water temperatures (15, 22 and 29 C) and two different media; experimental (dechlorinated tap water) and natural (filtered lake water) with an organochlorine insecticide, Endosulfan are reported. The 96-h LC50 decreased in the experimental medium ($p < 0.05$) by an order of magnitude from 0.041 to 0.020 mg/L between 22 and 29 C. In the natural medium, it varies from 0.046 to 0.026 mg/L for these same temperatures ($p < 0.05$). The toxicity of endosulfan on eels increased when the water temperature increased (positive temperature coefficient), but there were no significant differences between the 24, 48, 72, and 96-h LC50 values ($p > 0.05$) between both media at the three respective temperatures studied (15, 22, and 29 C). The 24, 48, 72, and 96-h LC50 for this fish is similar or identical for these four times in both media at the three temperatures used in this study. Therefore, it is concluded that endosulfan is more toxic at higher temperatures and in the experimental medium; however, under these conditions the toxicity is independent of the time. (White-Reimer-PTT)
W89-12690

BIOACCUMULATION OF HEAVY METAL IONS AND THEIR EFFECT ON CERTAIN BIOCHEMICAL PARAMETERS OF WATER HYACINTH WEEVIL NEOCHETINA EICHHORNIAE (WARNER).
Regional Research Lab., Hyderabad (India).
M. S. Hussain, and K. Jamil.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 24B, No. 3, p 251-264, June 1989. 2 tab, 22 ref.

Descriptors: *Water pollution effects, *Aquatic insects, *Bioaccumulation, *Heavy metals, Cadmium, Zinc, Manganese, Aquatic plants, Proteins, DNA, Weevils, Water hyacinth, Ligands, Path of pollutants, Cations, Biochemistry, Nucleic acids.

Water hyacinth plants treated for a week with varying concentrations (10-50 ppm) of soluble Cd, Mn, and Zn were fed to the phytophagous weevil Neochetina eichhorniae (Warner), which were subsequently examined for toxic effects and other parameters. The insects were processed for biochemical accumulation of metal ions and their effect on protein, DNA and RNA. The interference of Cd and Mn ions on protein synthesis was indicated by lower RNA and DNA contents in the treated than in the control group. Zinc was associated with an increase in RNA and DNA content and also a significant increase in protein synthesis. It was found that the bioaccumulation of metal ions in the leaves increases with an increase in concentration of Cd and Zn, whereas with Mn the bioaccumulation was not very significant. However, bioaccumulation in the insect body decreased with increase in concentration of the metal solution. This could be due to the reduced intake of plant material by the insect. The percentage of extractable metals from insect bodies declined as the metal concentration in the leaves they fed on increased. Therefore, it was concluded that significant biochemical and bioaccumulation differences existed between the various metal treatments. Metals act on the living system through their ligand binding property thereby interacting with either simple molecules like amino acids and other metabolites or macromolecules like proteins and nucleic acids. Zn is a catalytic element involved in the regulation of enzyme activity which is vital for biochemical reactions to proceed in the living system. The present results indicate that the Cd ion inhibited protein and nucleic acid syntheses while Mn showed relatively less effect. The changes in protein and nucleic acid concentrations due to the metals used in the present study suggest their possible interference with normal metabolism of protein and nucleic acids. (White-Reimer-PTT)
W89-12691

INDUCTION PATTERN OF LIVER MICROSOMAL ALKOXYRESORUFIN O-DEALKYLASES OF CHANNEL CATFISH (ICTALURUS PUNCTATUS): CORRELATION WITH PCB EXPOSURE IN SITU.
Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
G. W. Winston, S. Narayan, and C. B. Henry.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 24B, No. 3, p 277-289, June 1989. 3 fig, 2 tab, 29 ref.

Descriptors: *Water pollution effects, *Metabolism, *Enzymes, *Liver, *Polychlorinated biphenyls, *Catfish, Louisiana, Alkoxyresorufins, Fat tissue, Hepatic microsomes, Fate of pollutants, Bioaccumulation, Correlation analysis, Population exposure, In situ tests.

The hepatic microsomal-mediated O-dealkylation of various substituted alkoxyresorufins by channel catfish from Devil' Swamp, a highly polluted river basin ecosystem in southern Louisiana, were compared and correlated with the polychlorinated bi-

phenyl (PCB) contents from fat tissues of these fish. The specific activities and the turnover numbers of methoxy-, ethoxy-, pentoxy-, and benzyloxyresorufin O-dealkylases in Devil's Swamp microsomes was significantly elevated relative to that of channel catfish from a pristine reference site. The results suggest that the pattern of induction of alkoxyresorufin O-dealkylase activities in Devil's Swamp channel catfish microsomes is consistent with the pattern of induction that would be anticipated following exposure to mixed PCB. (Author's abstract)
W89-12692

TRANSFORMATIONS IN PHYTOCENOESIS DURING EUTROPHICATION (EKOLEBANIIAKH V FITOTSENOZAKH PRI EVTROFIROVANII).
Rostovskii-na-Donu Gosudarstvennyi Univ. (USSR). Nauchno-Issledovatel'skii Inst. Mekhaniki i Prikladnoi Matematiki.
V. G. Ilchev.
Gidrobiologicheski Zhurnal GBZUAM, Vol. 24, No. 5, p 15-22, 1988. 4 fig, 11 tab, 16 ref. English summary.

Descriptors: *Eutrophication, *Detritus, *Phytoplankton, *Mathematical models, Cycling nutrients, Nitrogen, Phosphorus, Biodegradation.

A mathematical model in a form of a set of different fractions, each having its own time of transformation to the mineral forms of nitrogen and phosphorus was developed. Detritus is shown to represent a bundle of feedbacks with delay in the process of substance cycling in the ecological system phytoplankton–biogenic elements and phytodegradation stability is determined by the diversity and coordination of the feedback family. (Author's abstract)
W89-12721

QUANTITATIVE EVALUATION OF SOME INDICATORS OF WATER QUALITY IN WATER COURSES (KOLICHESTVENNAIA OTSENKA FORMIROVANIIA NEKOTARYLEH POKAZATELEI KIACHESTVA VODY V VODOTOKAKH).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
O. P. Oksiiuk, and F. V. Stolberg.
Gidrobiologicheski Zhurnal GBZUAM, Vol. 24, No. 5, p 23-29, 1988. 6 fig, 1 tab, 14 ref. English summary.

Descriptors: *Eutrophication, *Mathematical models, *Water pollution effects, Biological oxygen demand, Dissolved oxygen, Phytoplankton, Biomass, Self-purification, Water quality, Algae, Diatoms, Cyanophyta.

Methods are suggested for the quantitative evaluation of total biological oxygen demand, concentration of dissolved oxygen and phytoplankton biomass from the length of eutrophied water courses using mathematical models. The models were constructed using structural and functional characteristics of the ecosystem with due regard for the processes of self-purification and biological pollution, including mass development of diatomic and blue-green algae as well as filamentous algae in overgrowths. (Author's abstract)
W89-12722

TOXICITY OF ALGAE AND THE DIFFICULTY OF ITS DETECTION IN NATURAL WATERS (A SURVEY) (TOKSICHNOST' VODOROSLEI I TRUDNOSTI II OBNARUZHENIIA V PRIRODNOI VODE (OBSOR)).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
L. A. Sirenko, and T. V. Parshikova.
Gidrobiologicheski Zhurnal GBZUAM, Vol. 24, No. 5, p 48-58, 1988. 76 ref. English summary.

Descriptors: *Toxicity, *Eutrophication, *Water pollution effects, *Algal toxins, *Bioindicators, *Water analysis, Toxins, Monitoring, Water quality.

The toxicity of natural populations of algae was analyzed. It is concluded that when estimating water quality and its biological status, especially under integral analysis of natural waters samples from highly eutrophic water bodies, the possibility of finding algal toxins together with bacterial toxins and mycotoxins should be kept in mind. If algal analysis is a necessary element of environmental monitoring in estimating water quality and toxicity, mycological control is not practically used for these purposes. (Author's abstract)
W89-12723

EFFECT OF LINEAR ALKYL BENZENE SULPHONATE ON GERMINATION OF SPORES OF THE AQUATIC FERN CERATOPTERIS THALICTROIDES.
National Botanical Research Inst., Lucknow (India).
J. Singh, and S. Devi.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 43, No. 1, p 111-117, July 1989. 8 fig, 2 tab, 15 ref.

Descriptors: *Water pollution effects, *Linear alkyl sulfonates, *Aquatic plants, *Germination, *Spores, *Ferns, Fluoresecence, Phytotoxicity, Culturing techniques, Detergents, Microscopy, Plant growth, Plant pathology, Mortality, Plant morphology, Lethal limit, Median tolerance limit.

The phytotoxicity of LAS on germination of an aquatic fern Ceratopteris thalictroides spores was studied. Only germination pattern was taken as an index and no observations were made on the developmental stages. Three petri dishes containing only Knops medium were kept as the control set. Mature fresh spores of Ceratopteris 2.0 mg were sprinkled with a paper spatula over the culture medium, containing different concentrations of the detergent. Fluorescence microscopy was done to study the structural differences in gametophytes, caused by detergent treatment. LAS at 10 ppm shows similar percentage of germination as control at 15 and 20 days, but antheridial development was more and faster in the treated spores. Higher concentrations of LAS decreased germination and development and also delayed antheridial formation. Beyond 75 ppm, lethality was 100%. Even though strict dose time response was not manifested, LAS was found to be toxic to fern spore germination. After 20 days, no antheridial initiation was observed in control or in other concentrations, whereas fifty percent of the gametophytes in 10 ppm developed antheridia. The number, width and length of the rhizoids of control were always higher than those of 10 ppm. (Miller-PTT)
W89-12737

HISTOPATHOLGICAL CHANGES INDUCED BY MALATHION IN THE GILLS OF BLUEGILL LEPOMIS MACROCHIRUS.
Kent State Univ., OH. Dept. of Biological Sciences.
C. Richmonds, and H. M. Dutta.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 43, No. 1, p 123-130, July 1989. 7 fig, 1 tab, 15 ref.

Descriptors: *Tissue analysis, *Animal pathology, *Bluegills, *Pesticides, *Water pollution effects, *Insecticides, *Malathion, *Gills, Fish diseases, Histopathology, Sunfish, Pesticide toxicity, Mucus, Experimental design, Population exposure, Sublethal effects, Mortality, Bioassay, Degeneration.

The effects of malathion on the gills of bluegill sunfish, Lepomis macrochirus, were studied. Replicates of 10 fish were exposed to a concentration of 0.05 mg/L malathion for 24, 48, 72 and 96 hr. Five fish were sampled at each testing period. After 24 hr of exposure to 0.05 mg/L malathion some mild degenerative changes were seen in the interlamellar region and epithelial lining of the secondary lamellae. The lifting up of the epithelium, some necrosis, exudation and bulging at the tip of the primary filament were noticed after 24 hr of exposure. The damage was more pronounced after 48 hr of exposure. Necrosis of the secondary lamella, further lifting up of the epithelium and intraepithelial edema were observed after 48 hr of exposure. Ninety-six hr of exposure resulted in a pathological condition called the bulbing of the secondary lamella or clavate lamella. One fish died around 78 hr and two died around 84 hr of exposure. None of the control fish died during this period. After exposure, an excessive amount of mucus was found over the gills of live specimens. Under the same exposure conditions, different gills and lamellae showed different degrees of degenerative changes. (Miller-PTT)
W89-12739

PATHOLOGY OF BROWN BULLHEAD, ICTALURUS NEBULOSUS, FROM HIGHLY CONTAMINATED AND RELATIVELY CLEAN SECTIONS OF THE HUDSON RIVER.
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
J. C. S. Kim, E. S. Chao, M. P. Brown, and R. Sloan.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 43, No. 1, p 144-150, July 1989. 2 tab, 18 ref.

Descriptors: *Animal pathology, *Water pollution effects, *Bullhead, *Hudson River, Pathology, Contamination, Comparison studies, Path of pollutants, Fish, Polychlorinated biphenyls, Tissue analysis, Weight, Statistical analysis, Muscle, Cadmium, Lead, Mercury, Toxicity, Liver, Kidneys, Blood, Population exposure, Biological samples.

During June 16-20, 1986, brown bullhead were collected from the Hudson River by electroshocking. PCB concentrations in fillets of 21 control-site (clean-water) fish and 20 experimental-site (contaminated-water) fish selected to represent the spectrum of ages within each sample, were determined. Age determinations were made using the pectoral spine sectioning method. Average weight but not average length differed significantly between control and experimental samples. No site-by-sex interaction was detected. The mean condition factor of experimental fish was significantly lower than that of the control fish. There were no differences in mean condition factors between sexes at a collection site. The respective mean ages of control and experimental fish were 2.6 and 3.2 years. There was a significant difference in age distribution between control and experimental groups. The PCB concentrations in skeletal muscle reflect the substantially greater exposure of fish in the experimental group to PCB than in the control group. Respective mean PCB concentrations for control and experimental groups were 0.61 and 38 microg/g. The highest observed PCB concentration in the control group was 1.4 microg/g. The lowest PCB concentration in the experimental group was 16.3 microg/g. There were no significant differences in the prevalence of gross abnormalities between the two groups. The prevalence of various histpathologic observations differ from gross observations with the former considered definitive. Although sex ratios in the control group and experimental groups were different, within each group there was no significant difference in the extent of bile-duct hyperplasia between males and females ($p > 0.05$). The presence of highly excessive hemosiderin in liver and spleen and kidneys suggest the excessive breakdown of red blood cells. The toxic mechanism underlying such hemolyses are largely unknown, although metals such as cadmium, lead, and mercury are suspected causative agents. (Miller-PTT)
W89-12742

HEAVY METAL TOXICITY TO FIDDLER CRABS, UCA ANNULIPES LATREILLE AND UCA TRIANGULARIS (MILNE EDWARDS): RESPIRATION ON EXPOSURE TO COPPER, MERCURY, CADMIUM, AND ZINC.
Andhra Univ., Waltair (India). Dept. of Zoology.
V. U. Devi, and Y. P. Rao.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 43, No. 1, p 165-172, July 1989. 2 tab, 16 ref.

Descriptors: *Water pollution effects, *Heavy metals, *Copper, *Mercury, *Cadmium, *Zinc, *Toxicity, *Crabs, *Respiration, Population expo-

sure, Metabolism, Oxygen requirements, Inhibition, Sublethal effects, Acclimitization, Statistical analysis, Comparison studies.

Respiratory metabolism of fiddler crabs, Uca annulipes and Uca triangularis, of Viskhapatnam Harbor was examined by exposing them to different test concentrations of heavy metals. Cu, Cd, Hg, and Zn were used because these are the chief pollutants in their environment. A comparison was also made with the respiratory metabolism of their counterparts collected from an unpolluted environment (Bhimilipatnam). The effect of different test concentrations of Cu, Cd, Hg and Zn on oxygen consumption is presented for U. annulipes and U. triangularis. It is clear from the results that all of these heavy metals are found to inhibit the rates of respiration, but the degree of inhibition varies from metal to metal. From the percentage decrease values, it is evident that the effect of heavy metals is more on U. annulipes and U. triangularis of Bhimilipatnam than their counterparts of Visakhapatnam Harbor. The effect of heavy metals on oxygen consumption in both species of crabs was in the order of Hg > Cd > Cu > Zn. The decrease in the respiratory rates of both species was observed to be higher when exposed to different concentrations for 48 hr than for 96 hr. However, the effect of LC0 and LC25 at 96 hr was not significant ($p > 0.01$) in both species for all four metals. The relatively lower rates of percentage decrease in the respiration and the insignificant decrease in the respiratory rates observed at LC0 and LC25 at 96 hr in both species of crabs at Visakhapatnam Harbor indicate their resistance to these heavy metals when compared to those of Bhimilipatnam. This can be explained by the fact that both species of crabs of Visakhapatnam harbor experience an exposure to heavy metals in the environment. Therefore, they might have developed resistance. (Miller-PTT)
W89-12744

EPISODIC FISH KILLS IN AN ACIDIFIED SALMON RIVER IN SOUTHWESTERN NORWAY.
Direktoratet for Vilt og Ferskvannsfisk, Trondheim (Norway). Fish Research Div.
T. Hesthagen.
Fisheries (Bethesda), Vol. 14, No. 3, p 10-17, May/June 1989. 4 fig, 5 tab, 48 ref.

Descriptors: *Acid rain effects, *Water pollution effects, *Rivers, *Fishkill, *Salmon, *Trout, *Norway, *Acid streams, Hydrogen ion concentration.

Fish kill assessments of Atlantic salmon (Salmo salar) and brown trout (Salmo trutta) were conducted and the cause of the kill was associated with environmental acidification during the snowmelts. The river Vikedalselva in southwestern Norway was studied each spring from 1982 to 1985. River acidity was measured daily in 1982 and continually from 1983 to 1985. Fish kill was assessed daily by inspecting stretches of the river bottom. A total of 680 carcasses of Atlantic salmon and brown trout were either recovered or counted. Most of the dead specimens were juvenile fish of which a predominant fraction were > or = 2 years old (presmolts) Mortality varied considerably between years, from a high of 386 specimens in 1984 to a low of 34 in 1985. Another 39 specimens were observed drifting in the river. The fish kills were generally episodic, and usually followed sudden increases in discharge and depressions of river pH. With the exception of 1983, a correlation analysis using linear regression revealed a significant inverse relationship between daily pH and the number of dead salmon and trout recovered. Depression of pH did not cause instantaneous death, and peak abundance of carcasses found was delayed relative to the initiation of these episodes. This is probably because fish became stressed prior to prevailing runoff conditions; in 1985, when runoff was low due to thin snow cover and lesser amounts of rain, mortality was insignificant. This indicates a correlation between pH and mortality of Atlantic salmon and brown trout. However, such field studies are subject to some irregularities between the river acidity and fish kill. This may be related to the method used for assessing the fish kill or to hydrological and biological factors. (Author's abstract)
W89-12747

EFFECTS OF CU, CD AND ZN ON PHOTOSYNTHESIS OF FRESHWATER BENTHIC ALGAE.
National Inst. for Environmental Studies, Tsukuba (Japan).
N. Takamura, F. Kasai, and M. M. Watanabe.
Journal of Applied Phycology, Vol. 1, No. 1, p 39-52, April 1989. 3 fig, 4 tab, 27 ref. Japan Ministry of Education, Science and Culture Grant no. 63602548.

Descriptors: *Water pollution effects, *Copper, *Cadmium, *Zinc, *Benthic flora, *Algae, *Photosynthesis, Freshwater, Population exposure, Heavy metals, Tolerance.

One hundred and eighteen algal isolates comprising seven classes were obtained for a range of sites from polluted rivers running through Cu or Zn mining regions, and from unpolluted rivers. All the isolates were tested for photosynthetic activity when exposed to Cu, Cd, or Zn. The tolerance levels of Bacillariophyceae, Charphyceae, Cyanophyceae and Chlorophyceae to Cu showed significant positive correlations with Cu concentrations in the field. However, the distribution of metal sensitivities of the algae from the sites with the same metal concentration was broad. Both Bacillariophyceae and Charphyceae had a number of strains whose sensitivity to Cu differed more widely in relation to Cu levels in the environment than Cyanophyceae and Chlorophyceae. Cyanophyceae were sensitive to all three metals, whether or not isolates were obtained from polluted sites, whereas Chlorophyceae tended to have high tolerance even in isolates from unpolluted sites. For Cd and Zn, the correlation between tolerance levels and concentrations in the field are not so clear as for Cu. The occurrence of Cu tolerance was shown in four diatom species and one Charaophyceae, whereas metal resistance occurred in some Chlorophyceae. Cu-tolerant isolates tended also to be Zn-tolerant in Bacillariophyceae, and Cd-resistant isolates tended also to be Zn-resistant in Chlorophyceae. (Author's abstract)
W89-12754

LARGE COMMUNITY OUTBREAK OF CRYPTOSPORIDIOSIS DUE TO CONTAMINATION OF A FILTERED PUBLIC WATER SUPPLY.
Centers for Disease Control, Atlanta, GA.
For primary bibliographic entry see Field 5F.
W89-12764

RAPID EVOLUTION OF METAL RESISTANCE IN A BENTHIC OLIGOCHAETE INHABITING A METAL-POLLUTED SITE.
State Univ. of New York at Stony Brook. Dept. of Ecology and Evolution.
P. L. Klerks, and J. S. Levinton.
Biological Bulletin (Marine Biological Laboratory) BIBUBX, Vol. 176, No. 2, p 135-141, April 1989. 4 fig, 28 ref.

Descriptors: *Cadmium, *Evolution, *Oligochaetes, *Nickel, *Adaptation, *Benthic fauna, *Water pollution effects, Population exposure, Heavy metals, Genetics, Resistance.

A case of very rapid evolution of resistance in a common freshwater benthic invertebrate to sediment with extremely high levels of cadmium and nickel was identified. Limnodrilus hoffmeisteri from metal-polluted sites in Foundry Cove, New York was significantly more resistant than conspecifics from a nearby control site, to both metal-rich natural sediment and metal-spiked water. Resistance differences were also found among sites within Foundry Cove. Elevated resistance in Foundry Cove worms was genetically determined, as it was still present after two generations in clean sediment. Resistance evolved rapidly, within 30 years. A laboratory selection experiment and estimates of the heritability of this resistance in L. hoffmeisteri from the control site indicated that the resistance could have evolved in 1 to 4 generations. Laboratory selection resulted in a large increase in resistance after two generations of selection, while we demonstrated that most of the phenotypic variation was additive genetic; heritability estimates ranged from 0.59 to 1.08. (Author's abstract)
W89-12769

EFFECT OF JUGLONE ON FRESHWATER ALGAL GROWTH.
Bloomsburg Univ., PA. Dept. of Life and Health Sciences.
C. T. Kessler.
Journal of Chemical Ecology JCECD8, Vol. 15, No. 7, pp. 2127-2134, July 1989. 2 tab, 34 ref.

Descriptors: *Phenols, *Inhibitors, *Juglone, *Algal growth, Aquatic productivity, Walnut trees, Toxicity, Fish, Biomass, Species diversity.

Allelopathic growth inhibition of various freshwater algal species was observed upon the addition of juglone to culture medium under laboratory conditions. Juglone is a phenolic chemical compound common to most parts of the black walnut (Juglans nigra L.). Growth inhibition of all species occurred at a juglone concentration of .001 M. Three of the five species were inhibited by a concentration of .0001 M juglone, while no inhibition occurred at .00001 M juglone. The results of this study indicate that juglone is less toxic to algae than fish. Therefore, the potential of juglone for aquatic management purposes is limited. Algal biomass will increase at natural juglone concentrations from 10 to the minus 8th power to .0001 M due to the elimination of secondary producers. Algal biomass will decrease at natural juglone concentrations between .0001 and .001 M. Species richness will decrease at juglone concentrations of .00001 and higher. (Author's abstract)
W89-12773

CYANOBACTERIAL TOXINS IN WATER.
Dundee Univ. (Scotland). Dept. of Biological Sciences.
G. A. Codd, S. G. Bell, and W. P. Brooks.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 1-13, July 19, 1989. 1 fig, 2 tab, 69 ref.

Descriptors: *Pollutant identification, *Toxins, *Cyanophyta, *Algal toxins, *Water pollution effects, *Reviews, Drinking water, Domestic animals, Wildlife, Public health, Assay, Bioassay.

Cyanobacteria commonly occur in fresh-water and brackish waters and may produce massive annual growth as a consequence of nutrient enrichment from natural waters, agricultural fertilizer run-off, or from domestic/industrial effluents. The cyanobacterial species which dominate these growths typically belong to the genera which produce toxins. These toxins cause fatal poisonings of agricultural livestock, wild animals, birds and fish on a world-wide basis. The involvement of the toxins in human health problems has also been inferred in several countries and their presence in drinking water sources is of interest to the drinking water industry. Cyanobacterial blooms have been detected in freshwaters in the United Kingdom, Norway, Sweden, Finland, and Hungary. New methods are being developed for the purification of the toxins and for their recovery and quantification from waters. These include the use of chemical, cytotoxicity and immunological methods to complement the mouse bioassay. Information on the regulation of cyanobacterial toxin production and on the possible biological significance of the toxins in aquatic environments is also presented. A greater awareness of cyanobacterial toxins in waters destined for human use is required. (Author's abstract)
W89-12779

RECREATIONAL AND AMENITY USE OF SURFACE WATERS: THE PUBLIC HEALTH IMPLICATIONS.
Altwell Ltd., Warrington (England).
For primary bibliographic entry see Field 5F.
W89-12799

PLASMID-DETERMINED RESISTANCE TO SILVER IN ENTEROBACTER CLOACAE ISOLATED FROM SEWAGE.
Yamanashi Medical Coll. (Japan). Dept. of Environmental Health.
H. Nakahara, I. Yonekura, A. Sato, K. Moriyama, and Y. Kobayashi.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 275-278, July 19, 1989. 1 fig, 11 ref. Ministry of Education, Science and Culture of Japan, grant 62602010.

Descriptors: *Tolerance, *Disinfection, *Bacterial analysis, *Sewage bacteria, *Enterobacter, Silver resistance, Plasmids, Water pollution.

Microbial Ag toxicity is found in situations of industrial pollution, especially those associated with the use of photographic film. In hospitals, Ag salts are the preferred antimicrobial agents for burns. It is well known that Ag-resistant bacteria with plasmids encoded for Ag resistance can be isolated from polluted industrial sites and hospitals. The Ag resistance of 5 strains of Enterobacter cloacae isolated from contaminated sewage was investigated. In one of these strains, a high frequency of inactivation of Ag resistance was achieved by treatment with ethidium bromide and acriflavine (inactivation frequencies of 23.3% and 17.7%, respectively). The maximum concentration of AgNO3 at which plasmid-less Ag-sensitive strains could be grown was 20 mg/l. The maximum concentration of AgNO3 at which Ag-resistant strains were able to grow was 10,000 mg/l, i.e., 500 times that for Ag-sensitive strains. Agarose gel electrophoretic profiles showed that the DNA with higher mobility, i.e., plasmids, present in the Ag-resistant cells was inactivated by treatment with ethidium bromide and acriflavine. Viable organisms of Ag-resistant and Ag-sensitive strains at about 100 million colony-forming units per ml were inoculated into broth containing AgNO3. The concentrations of AgNO3 in the supernatants were measured by atomic absorption spectrophotometry. A decrease in the concentration of AgNO3 was observed. The concentrations decreased to below 50% of the initial value after 24 h, and to almost 0% (trace) after 1 week. (Author's abstract)
W89-12822

DIFFERENCES IN HYDROCARBON UPTAKE AND MIXED FUNCTION OXIDASE ACTIVITY BETWEEN JUVENILE AND SPAWNING ADULT COHO SALMON (ONCORHYNCHUS KISUTCH) EXPOSED TO COOK INLET CRUDE OIL.
California State Univ., Chico. Dept. of Biological Science.
R. E. Thomas, S. D. Rice, M. M. Babcock, and A. Moles.
Comparative Biochemistry and Physiology (C) CBPCEE, Vol. 93, No. 1, p 155-159, 1989. 3 fig, 1 tab, 28 ref.

Descriptors: *Alaska, *Salmon, *Oil pollution, *Hydrocarbons, *Enzymes, *Water pollution effects, Ecological effects, Environmental effects, Bioaccumulation.

Juvenile and adult spawning coho salmon were exposed to crude oil water-soluble fraction in flow-through systems (0.41 ppm for up to 12 days, and 0.42 ppm for up to 20 days, respectively). Aromatic hydrocarbon concentrations in liver, gut and muscles were determined by gas chromatography. Coho salmon smolts accumulated up to 30 times more hydrocarbon in selected tissues than did coho salmon jacks when exposed to water-soluble fraction of Cook Inlet crude oil. Aryl hydrocarbon hydroxylase activity continued to increase during 12 days of exposure in coho smolts, in contrast to jacks in which aryl hydrocarbon hydroxylase activity peaked at 2 days and remained elevated during 20 days of exposure. Cytochrome P-450 concentrations peaked in 48 hr and returned to control levels in exposed smolts. In exposed and control jacks, cytochrome P-450 decreased during the 20 day experimental period. Concentrations of P-450 were significantly greater, however, in exposed jacks than in control jacks. Aryl hydrocarbon hydroxylase activity and cytochrome P-450 concentrations were greater in non-exposed coho smolts and jacks than in non-exposed pre-spawning adults. Coho jacks were not as responsive as coho smolts in terms of P-450 induction, however, they were more responsive than anticipated for a fish in a terminal life stage. (Author's abstract)
W89-12833

TOXIC EFFECTS OF MERCURIALS ON THYROID FUNCTION OF THE CATFISH, CLARIAS BATRACHUS (L).
Banaras Hindu Univ., Varanasi (India). Centre of Advanced Study in Zoology.
R. Kirubagaran, and K. P. Joy.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 3, p 265-271, June 1989. 1 fig, 1 tab, 25 ref.

Descriptors: *Mercurials, *Catfish, *Water pollution effects, *Mercury, Iodine, Pesticides, Thyroid.

The toxic effects of mercurials on the thyroid activity of Clarias batrachus were evaluated after exposure for 45, 90, and 180 days during gonadal recrudescence. Histologically, the thyroid follicles were active with hypertrophied epithelium and reduced colloid content in 90-day and 180-day mercuric chloride (HgCl2) and 90-day methylmercuric chloride (CH3HgCl)-treated fish. In 180-day CH3HgCl and 90-day and 180-day emisan 6 groups, the follicular epithelium appeared atrophic with a wavy and irregular outline and with hypertrophied and hyperplastic cells present in some parts of the epithelium. Thyroidal I131 uptake was inhibited in all groups and at all durations. Protein-bound iodine (PBI) levels decreased significantly in the 45-day CH3HgCl group and in all the mercurial groups treated for 90 and 180 days. Of the three mercurials, CH3HgCl was found to be more toxic than the other two in inhibiting thyroidal I131 uptake and PBI level at all durations. (Author's abstract)
W89-12834

CYTHION-INDUCED HISTOPHYSIOLOGICAL CHANGES IN THYROID AND THYROTROPHS OF THE TELEOST FISH, CHANNA PUNCTATUS (BLOCH).
Banaras Hindu Univ., Varanasi (India). Centre of Advanced Study in Zoology.
R. N. Ram, K. P. Joy, and A. G. Sathyanesan.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 3, p 272-278, June 1989. 6 fig, 22 ref.

Descriptors: *Organophosphorus pesticides, *Fish, *Water pollution effects, Iodine, Pituitary, Ecological effects, Fish physiology, Cythion, Thyroid.

The chronic effects of continuous exposure for 6 months, from January to June, to safe (2.0 ppm) and sublethal (4.0 ppm) concentrations of a commonly used organophosphorus pesticide, cythion, on the histophysiology of the thyroid and thyrotrophs in Channa punctatus are described. The pharyngeal thyroid of fish of both treated groups exhibited hypertrophy and hyperplasia of the follicular epithelium and reduction of colloid content. Apart from this, in the fish exposed to 4.0 ppm, some of the follicles were exhausted and transformed into degenerated cystic masses. The presence of free blood cells at these sites suggests rupture of blood vessels and possible phagocytosis. These histopathological changes could be correlated with a significant and dose-dependent reduction of thyroidal radioiodine uptake and conversion ratio (serum protein-bound iodine:total serum iodine) values. After cythion exposure, the thyrotrophs in the pituitary were activated. These results suggest that the thyroid dysfunction caused by cythion may be responsible for the stimulation of the thyrotrophs which in turn stimulated the thyroid follicles through the pituitary-thyroid axis in this species. (Author's abstract)
W89-12835

HISTOLOGICAL CHANGES IN THE KIDNEYS AND GILLS OF THE STICKLEBACK, GASTEROSTEUS ACULEATUS L., EXPOSED TO DISSOLVED CADMIUM IN HARD WATER.
London Univ. (England). Dept. of Biological Sciences.
J. A. Oronsaye.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 3, p 279-290, June 1989. 7 fig, 18 ref.

Descriptors: *Cadmium, *Kidneys, *Gills, *Water pollution effects, *Hardness, Fish physiology, Ecological effects.

The effects of exposure to hard water (299 mg/liter as CaCO3) on the kidneys and gills of Stickleback fish were investigated in continuous flow laboratory conditions. Fish were exposed to 2 to 6 mg Cd(2+)/liter for periods ranging from 1 to 30 days and histological examinations were made using light microscopy. Kidneys of fish exposed to 2 and 4 mg Cd(2+)/liter were not appreciably different from controls after up to 20 days of exposure. In the 6 mg Cd(2+)/liter test solution changes were observed in the kidneys after 18 days. In general, the apical regions of the columnar cells which line the tubules were disintegrated. Evidence of tissue vacuolation was obvious, and dark granular masses were seen in the kidney tubules and lumina. The observed effects of 2 to 6 mg Cd(2+)/liter in hard water on the Stickleback gills were dependent on the lengths of exposure and the cadmium concentrations. Gills showed swelling and lifting up of epithelial layers of the secondary lamellae, and vacuolation of the gill filament. In the 6 mg Cd(2+)/liter test solution, the epithelial layer was detached and was completely sloughed off after 20 days. The secondary lamellae of the basal areas of the gill filaments were fused with the gill arch and those of adjacent gill filaments. The distal portions were similarly affected. (Geiger-PTT)
W89-12836

EFFECT OF METHYLAZOXYMETHANOL ACETATE ON BLUEGILL SUNFISH CELL CULTURES IN VITRO.
Rockefeller Univ., New York. Lab. Animal Research Center.
E. Borenfreund, H. Babich, and N. Martin-Alguacil.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 3, p 297-307, June 1989. 4 fig, 1 tab, 31 ref. U.S. EPA Grant 813760.

Descriptors: *Methylazoxymethanol, *Bluegills, *Sunfish, *Carcinogens, *Water pollution effects, Gills, Ecological effects, Fish physiology.

An epithelioid cell line derived from fine tissue of bluegill sunfish (designated BG/F) exhibited early indications of cell transformation upon exposure to methylazoxymethanol acetate (MAM acetate) at concentrations of 5 or 10 micrograms/liter for 24 hr. Such changes included the induction of polyploidy, increased colony-forming efficiency, loss of contact inhibition, and formation of transformed foci. Unlike later transformation characteristics observed with mammalian cells, the MAM acetate-treated BG/F cells could not be propagated under conditions of anchorage independence in soft agar. Incubation of BG/F cells with N-methyl-N'-nitro-N-nitrosoguanidine, followed by exposure to 12-O-tetradecanoyl-phorbol-13-acetate, was not observed to cause cell transformation under the experimental conditions. The controls of a fibroblastic cell culture derived from gill tissue of bluegill sunfish showed spontaneous transformation after 6 months of passage, similar to the transformation observed in the experimental MAM acetate treated gill cultures. (Author's abstract)
W89-12837

FATE AND EFFECTS OF SALICYLIC ACID COMPOUNDS IN FRESHWATER SYSTEMS.
Academia Sinica, Beijing (China). Research Center for Eco-Environmental Sciences.
For primary bibliographic entry see Field 5B.
W89-12838

RECOVERY OF BENTHIOCARB-INHIBITED ACHE IN FISH BRAIN: AN IN VITRO STUDY.
Sri Venkateswara Univ., Tirupati (India). Dept. of

Zoology.
For primary bibliographic entry see Field 5B.
W89-12839

TOXICITY OF HEAVY METALS TO EARLY LIFE STAGES OF DAPHNIA MAGNA.
Utrecht Rijksuniversiteit (Netherlands). Research Group for Aquatic Toxicology.
C. W. Bodar, A. V. Zee, P. A. Voogt, H. Wynne, and D. I. Zandee.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 3, p 333-338, June 1989. 3 fig, 19 ref.

Descriptors: *Toxicity, *Daphnia, *Cadmium, *Zinc, *Copper, *Lead, *Water pollution effects, Heavy metals, Ecological effects.

The susceptibility of the parthenogenetic eggs of Daphnia magna to cadmium, zinc, copper, and lead was examined in laboratory tests. Various early life stages of D. magna were exposed to Zn (10.0, 50.0, and 100.0 mg/liter), Cu (1.0, 10.0, and 25.0 mg/liter), Cd (1.0, 10.0, and 50.0 mg/liter), and Pb (1.0, 10.0, and 25.0 mg/liter) for 8, 19, 26, 34, and 46 hr. Cd and Cu exposure at concentrations exceeding 1.0 mg/liter profoundly affected total development of the daphnid eggs. High concentrations of lead and zinc (except for 100 mg/liter) had no significant effect on death rates of early life stages. Only a slight decrease in the mean lifetime of individuals in stages 1 (egg) and 2 (headless embryo) were noted at Cu concentrations of 10.0 and 25.0 mg/liter and a Cd concentration of 50.0 mg/liter. In general, early life stages of D. magna turned out to be more tolerant to heavy metals than the adult stage according to recently calculated Cd 48-hr LC50 values for 21-day-old D. magna. (Geiger-PTT)
W89-12841

SAFETY ASSESSMENT OF BORON IN AQUATIC AND TERRESTRIAL ENVIRONMENTS.
Environmental Resources Ltd., London (England).
L. Butterwick, N. De Oude, and K. Raymond.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 3, p 339-371, June 1989. 4 fig, 11 tab, 120 ref.

Descriptors: *Boron, *Environmental effects, *Water pollution effects, *Fish, *Aquatic plants, Ecological effects, Irrigation effects, Path of pollutants, Wastewater irrigation, Water pollution sources, Toxicity, Grazing, Mammals.

The ecotoxicology and environmental safety of boron in aquatic and terrestrial environments is assessed. Data for toxicological effects of boron are compared with environmental concentrations of boron measured in Europe and the U.S. In general, environmental concentrations of boron found in surface water are below levels identified as toxic to aquatic organisms. Concentrations high enough to produce toxic effects in laboratory tests are found in areas where weathering of boron-rich formations and deposits occur, such as in the southwestern U.S. Reproducing populations of the most sensitive species, rainbow trout, were observed in surface waters in this region, indicating no cause for concern. The toxicity of boron in seawater is similar to that in freshwater. Boron toxicity to amphibians was similar to that in fish. Boron was more toxic to Daphnia magna in the form of sodium perborate. In studies with phytoplankton, a boron concentration of 30 mg/liter reduced photosynthesis in half the species tested. A concentration of 40.3 mg B/liter added as a tetraborate salt leads to a 50% inhibition of root growth in the freshwater plant Myriophyllum spicatum after 32 days of treatment. The major concern for effects on terrestrial plants centers on the use of irrigation water with elevated levels of boron. There is no evidence of widespread damage to crops resulting from this practice, however, crops grown are generally confined to those relatively insensitive to boron toxicity. Good irrigation practices will be required in arid regions with high evapotranspiration rates, especially in areas with naturally high boron levels. Sheep have developed enteritis from grazing on grasslands grown on boron rich soils. (Geiger-PTT)
W89-12842

USE OF NAK RATIOS IN LEAF TISSUES TO DETERMINE EFFECTS OF PETROLEUM ON SALT EXCLUSION IN MARINE HALOPHYTES.
Bowdoin Coll., Brunswick, ME. Marine Research Lab.
E. S. Gilfillan, D. S. Page, A. E. Bass, J. C. Foster, and P. M. Fickett.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 6, p 272-276, June 1989. 2 fig, 2 tab, 30 ref.

Descriptors: *Sodium, *Potassium, *Aquatic plants, *Oil pollution, *Water pollution effects, Salt marshes, Mangrove swamps, Spartina, Marine sediments, Hydrocarbons.

The relationship between sediment hydrocarbon concentration and leaf sodium/potassium (Na/K) ratios was examined in two marine halophytes, Rhizophora mangle and Spartina alterniflora. The plants were exposed to petroleum hydrocarbons in the field. Elevated Na/K ratios were observed in the leaves of both species of halophytes. The degree of elevation of the Na/K ratios was related to the concentration and state of weathering of petroleum in the sediments in which the plants were growing. In R. mangle leaves, elevated Na/K was significantly associated with reduced weathering ratio of sediment hydrocarbons. In S. alterniflora, significant effects on Na/K are found only as a result of two whole oil treatments. The mechanism of damage appears to be similar in both species, i.e. damage to root membranes from the petroleum hydrocarbons. (Geiger-PTT)
W89-12853

EFFECT OF CHEMICAL STRUCTURE AND MOLECULAR WEIGHT OF COMMERCIAL ALKYLBENZENES ON THE TOXIC RESPONSE OF DAPHNIA AND NATURALLY OCCURRING BACTERIA IN FRESH AND SEAWATER.
Barcelona Univ. (Spain). Dept. of Microbiology.
J. Martinez, J. Vives-Rego, and J. Sanchez-Leal.
Water Research WATRAG, Vol. 23, No. 5, p 569-572, May 1989. 4 tab, 21 ref.

Descriptors: *Water pollution effects, *Sulfur compounds, *Surfactants, *Marine bacteria, *Aquatic bacteria, *Toxicity, *Daphnia, Biodegradation, Molecular structure, Bioassay.

The toxicity of linear alkylbenzene sulfonate (LAS) of different molecular weight and branched alkylbenzene sulfonate (BABS) on naturally occurring bacteria was studied by thymidine incorporation. Six different alkylbenzene sulfonates were tested, five derived from LAS and one based on BABS. The acute toxicity tests on Daphnia were conducted following the procedure of the OECD IC50 at 24 hr exposure. The toxicity of the LAS were directly proportional to the molecular weight of the hydrocarbon chain. BABS exhibited a lower acute toxicity than LAS compounds. Fresh and seawater samples collected throughout the year of 1986 were used to assay the toxicity of intact LAS and BABS. There was a correlation between the inhibition of thymidine incorporation and the concentration of the surfactants, with LAS compounds showing greater EC50 values than BABS. A direct proportionality between the molecular weight and the obtained EC50 was evident in seawater as well as in freshwater, for the LAS compounds used. BABS was far less toxic than the LAS compounds used, despite its higher molecular weight compared with the other LAS molecules, with the exception of LAS-255. Most of the surface waters analyzed contained < 0.1 milligrams/liter of MBAS. It is suggested that an interference with the thymidine assay could exist only when the MBAS content in the surface waters is higher than 0.2 milligrams/liter, regardless of the MBAS origin (intact or intermediate compounds). (Geiger-PTT)
W89-12861

COMPARISON OF THE EFFECT OF TRICLOPYR TRIETHYLAMINE SALT ON TWO SPECIES OF DUCKWEED (LEMNA) EXAMINED FOR A 7- AND 14-DAY TEST PERIOD.
Dow Chemical Co., Midland, MI. Dept. Health and Environmental Sciences.
U. M. Cowgill, D. P. Milazzo, and B. D. Landenberger.
Water Research WATRAG, Vol. 23, No. 5, p 617-623, May 1989. 9 tab, 17 ref.

Descriptors: *Duckweed, *Water pollution effects, *Herbicides, *Toxicity, *Bioassay, *Bioindicators, Biomass, Chlorophyll a, Chlorophyll b, Nutrients.

A study was conducted to estimate the level of phytotoxicity (50% reduction in the number of plants or fronds as compared to controls) to five clones of Lemna over a 7 and 14-day period. The end-points examined were the number of fronds, the number of plants, biomass, chlorophyll a and chlorophyll b. All data gathered during the investigation confirm the fact that this herbicide is only slightly toxic to duckweed clones using the U.S. EPA classification scheme. There is no statistically significant difference among the five end-points for the 7-day test for any of the plant clones with the exception of chlorophyll b. The 14-day results were not nearly as consistent. L. gibba G-3 is more sensitive than the four clones of L. minor. The EC50 for biomass is more tolerant in L. minor 6591, L. minor 7102 and L. minor 7101 than for L. gibba G-3. The difference of greatest interest is that of chlorophyll production between the two test periods. In all cases chlorophyll a is significantly reduced in the 14-day test over that of the 7-day test, while chlorophyll b is only significantly reduced in the 14-day test for L. minor 6591, L. minor 7102 and L. minor 7136. It was hypothesized that the reason for this is that the system runs out of nutrients. This militates against the use of the 14-day test and favors the use of the 7-day one. (Author's abstract)
W89-12866

GROWTH AND PRODUCTION OF THE GREEN ALGA CLADOPHORA MONTAGNEANA IN A EUTROPHIC AUSTRALIAN ESTUARY AND ITS INTERPRETATION USING A COMPUTER PROGRAM.
Western Australia Univ., Nedlands. Dept. of Botany.
For primary bibliographic entry see Field 2L.
W89-12868

AQUATIC INVERTEBRATE SURVEYS AS A WATER QUALITY MANAGEMENT TOOL IN THE ANGLIAN WATER REGION.
Anglian Water Authority, Lincoln (England). Lincoln Div.
For primary bibliographic entry see Field 5A.
W89-12913

EFFECTS OF WEATHERED FUEL OIL ON SOLUTE LEAKAGE, RESPIRATION AND PLASMOLYSIS IN EXCISED ROOT SECTIONS OF SPARTINA ALTERNIFLORA LOISEL AND LIMONIUM CAROLINIANUM (WALT.) BRITT.
North Carolina State Univ., Raleigh. Highway Research Program.
F. L. Booker, E. D. Seneca, and U. Blum.
Environmental and Experimental Botany EEBODM, Vol. 29, No. 2, p 249-259, April 1989. 3 fig, 5 tab, 33 ref.

Descriptors: *Water pollution effects, *Plant physiology, *Oil pollution, Toxicity, Spartina alterniflora, Limonium carolinianum, Marshes, Coastal marshes, Salt marshes, Hydrocarbons, Respiration, Roots, Phytotoxicity.

The effects of petroleum on two salt marsh plant species, Spartina alterniflora Loisel and Limonium carolinianum were studied with plant material collected from the Cape Fear River and Newport River estuaries, North Carolina, and maintained in greenhouse hydroponic culture. Plants were also grown in pots of vermiculite. Studies of plasmalemma permeability, aerobic respiration, and plasmolysis in excised root sections showed that

weathered No. 2 fuel oil increased solute leakage from root sections in a dose-dependent manner; greater leakage occurred from Spartina than from Limonium roots. Plasmolysis experiments with Limonium were inconclusive because the root tissues did not tolerate the procedure. For oil treated Spartina, 100% and 80% of the tissue sections were viable at 2 and 5 hr after treatment, respectively. By 8 hr after treatment, only about 47% and 80% of the tissue sections treated with 40% and 80% oil, respectively, were scored as viable. Viability in the 0 and 20% oil treatments were an average of 52% greater than in the 40 and 80% oil treatments at either 8 or 10 hr after treatment. Aerobic respiration was also inhibited by weathered fuel oil to a greater extent in Spartina than in Limonium root sections. After 6 hr of weathered fuel oil exposure, the respiration rate with respect to the buffer was 0.58 for Spartina and 0.85 for Limonium. Differences in secondary growth and suberization appeared to account for the differential responses of the two species. (Cassar-PTT)
W89-12934

CAUSES AND CONSEQUENCES OF THE SUCCESS OF BREAM IN DUTCH EUTROPHIC LAKES.
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
E. H. R. R. Lammens.
Hydrobiological Bulletin HYBUD9, Vol. 23, No. 1, p 11-18, March 1989. 10 fig, 35 ref.

Descriptors: *Water quality control, *Lakes, *Lake restoration, *Predation, *Limnology, *Eutrophication, *Fish management, Ecosystems, The Netherlands, Food chains, Aquatic habitats, Habitats, Fish food, Invertebrates, Zooplankton, Shallow lakes, Eutrophic lakes, Algae, Pike, Bream.

The recent eutrophication of Dutch fresh waters has caused a shift in the species composition of fish communities and the disappearance of vegetation. Bream and pike-perch are now the dominant fish species in the turbid waters devoid of macrophytes. Only small bream is vulnerable to predation, but in about 3 yr this fast-growing fish is too large to be eaten by predators. Bream contribute to eutrophication by consuming zooplankton and allowing algal growth to proliferate and by stirring up sediment and increasing nutrient release to the water. The most productive food organisms in the lakes are pelagic and benthic cladocerans and copepods varying in size from 0.2 mm to 2 mm. The second most important group is larval chironomids, ranging in size from a few mm to a few cm. Gill-raker systems of bream, white bream, and roach differ in construction and coarseness so that the large bream are most fitted to sieving out the large chironomids from the deeper sediment layers. If the bream population consists mainly of large specimens, the daphnid population is affected only moderately. However, if the bream are generally smaller than 25 cm, Daphnia hyalina disappear and are replaced by D. cucullata. (Cassar-PTT)
W89-12937

THERMAL TOLERANCES OF COMMON CLADOCERA.
North Carolina Univ., Morehead City. Inst. of Marine Sciences.
For primary bibliographic entry see Field 2H.
W89-12953

STUDIES ON ALGAE OF POLLUTED PONDS OF KANPUR (INDIA). VIII. ROLE OF BLUE GREEN ALGAE.
D.A.V. Coll., Muzaffarnagar (India). Dept. of Botany.
S. N. Pandey, and A. K. Tripathi.
Phykos PHKSBF, Vol. 27, No. 1-2, p 38-43, 1988. 2 tab, 8 ref.

Descriptors: *Limnology, *Water pollution effects, *Ponds, *Eutrophication, *Algae, Cyanophyta, Kanpur, India.

Two ponds in Kanpur, India, were studied from March 1983 to February 1984. Chandari Pond, a wastewater pond situated in the heart of the city, receives industrial and domestic sewage. Kalyanpur Pond is mildly polluted, receiving runoff containing pollutants from defecation, bathing, and laundry in the catchment area. Algal populations were highest in summer and lowest in winter. Twelve genera and 51 species of cyanophyta were identified, of which 35 species appeared in Kalyanpur Pond and 41 in Chandari Pond. Algae found in both ponds included Aphanocapsa koordersi, A. pulchra, Aphanothece microscopica, A. pallida, A. saxicola, Chrococcus minutus, Microcystis aeruginosa, M. flos-aquae, M. protocystis. Of the algae, Anabaena beckii, A. flos-aquae and A. orientalis were the only three heterocysts. (Cassar-PTT)
W89-12967

ZINC INDUCED CHANGES IN GROWTH OF THE CYANOBACTERIUM SYNECHOCOCCUS (6031). CHARACTERISTICS OF ADAPTATION TO ELEVATED ZINC CONCENTRATION.
Jawaharlal Nehru Univ., New Delhi (India). School of Life Sciences.
A. Chintamani, and P. Mohanty.
Phykos PHKSBF, Vol. 27, No. 1-2, p 65-71, 1988. 6 fig, 12 ref.

Descriptors: *Water pollution effects, *Heavy metals, *Cyanophyta, Synechococcus, Zinc, Growth rates, Adaptation.

The blue-green algae Synechococcus (6301) was grown in a medium containing 6 microM of zinc. After eight or nine subcultures, the algae became conditioned so that they could grow at the elevated zinc level. During the initial subcultures with added zinc, phycocyanin and chlorophyll a levels were reduced. By the eighth subculture in 6 microM zinc, phycocyanin, chlorophyll a, and protein levels in the algae were similar to that of controls grown in 1 microM zinc medium. (Cassar-PTT)
W89-12968

LAKE ACIDIFICATION STUDIES: THE ROLE OF INPUT UNCERTAINTY IN LONG-TERM PREDICTIONS.
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
K. P. Georgakakos, G. M. Valle-Filho, N. P. Nikolaidis, and J. L. Schnoor.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1511-1518, July 1989. 2 fig, 4 tab, 19 ref. EPA cooperative agreement CR-812329-01-5 and NSF grant CES-8657526.

Descriptors: *Model studies, *Data requirements, *Water pollution sources, *Mathematical models, *Lakes, *Acid rain effects, *Hydrologic models, *Precipitation, Acidic water, Catchment areas, Temperature effects, Monte Carlo method, Forecasting, Data acquisition.

The importance of input uncertainty in long-term predictions of lake acidification was assessed. Mathematical models that simulate the behavior of hydrologic catchments under acid deposition require input data of precipitation, temperature, and deposition chemistry. In long-term studies of lake acidification it is necessary to hypothesize a scenario of future input to the mathematical models. Data from the Lake Woods hydrologic catchment, located in the Adirondack Park, New York, provided the input for a case study. The parameters of the proposed stochastic models for the input variables were estimated based on the available observations using a variety of methodologies ranging from the method of moments to the method of weighted least squares. The results showed that uncertainty in precipitation amount and acid concentrations can be very important in the characterization of future lake alkalinity levels. The natural day-to-day variability present in precipitation and other weather variables significantly affects long-term predictions of lake alkalinity in watersheds with short response time, even more than wet and dry weather cycles do. (Peters-PTT)
W89-12978

TOLERANCE LEVEL AND HISTOPATHOLOGICAL RESPONSE OF MILKFISH (CHANOS CHANOS) FINGERLINGS TO FORMALIN.
Southeast Asian Fisheries Development Center, Iloilo (Philippines). Aquaculture Dept.
For primary bibliographic entry see Field 8I.
W89-13005

OXYGEN CONSUMPTION, NEW PRODUCTION, VERTICAL ADVECTION AND ENVIRONMENTAL EVOLUTION IN THE MEDITERRANEAN SEA.
Paris-6 Univ. (France). Lab. de Physique et Chimie Mariens.
J. P. Bethoux.
Deep-Sea Research DESRAY, Vol. 36, No. 5A, p 769-781, May 1989. 4 fig, 2 tab, 44 ref.

Descriptors: *Eutrophication, *Water pollution effects, *Water pollution sources, *Mediterranean Sea, *Oxygen requirements, *Primary productivity, *Nutrients, *Phosphorus, *Water circulation, Vertical advection, Industrial wastewater, Urbanization, Decomposing organic matter.

New production in the Mediterranean Sea is linked to nutrient input from Atlantic surface water, terrestrial discharge and marine upward fluxes. In the Eastern and Western Basins, new production can be calculated from deep water circulation and oxygen consumption. New production and deep phosphorus outflow give an estimation of the upward fluxes of water and nutrients from the intermediate layer to the euphotic superficial layer. In the Eastern Basin, values for new production and the upward water flux are, respectively, 12 g C/sq m/y and 45 x 10 to the 15th power kg/y. In the Western Basin, new production (35 g C/sq m/y) and upward flux (62 x 10 to the 15th power kg/y) values confirm previous values deduced from water, salt and nutrient budgets. The relative importance of terrestrial discharge of nutrients and their probable increase due to industrial, agricultural and urban activities around the Mediterranean Sea necessitates one to consider the evolution of the oxygen concentrations. Assuming increased anthropogenic phosphorus inputs of 3% a year since the 1960s, as deduced from the increase of the deep water concentrations, due to the degradation of increasing organic matter linked to new production, the oxygen content of the deep layers will decrease early in the 21st century. (Author's abstract)
W89-13007

RISK OF FATAL AMEBIC MENINGOENCEPHALITIS FROM WATERBORNE NAEGLERIA FOWLERI.
Illinois Univ. at Chicago Circle. School of Public Health.
W. H. Hallenbeck, and G. R. Brenniman.
Environmental Management EMNGDC, Vol. 13, No. 2, p 227-232, March-April 1989. 78 ref.

Descriptors: *Human diseases, *Parasites, *Epidemiology, *Swimming, Risk assessment, *Protozoa, *Reviews, Naegleria, Amebic meningoencephalitis.

Primary amebic meningoencephalitis (PAM) is a fatal disease of the central nervous system caused primarily by the free-living ameba, Naegleria fowleri. PAM is primarily associated with swimming in various types of fresh water. World literature was reviewed in order to derive a risk analysis model that would be helpful in the management of PAM. The management of PAM is difficult, and the prevention of PAM is almost impossible. However, it is reassuring that the cases and risks estimated by the risk model are usually small, with individual annual risk on the order of 0.000001. (Author's abstract)
W89-13016

RECOVERY BY RIFFLE MACROINVERTEBRATES IN A RIVER AFTER A MAJOR ACCIDENTAL SPILLAGE OF CHLORPYRIFOS.
Polytechnic of Central London (England). Applied Ecology Research Group.
P. J. Raven, and J. J. George.
Environmental Pollution ENPOEK, Vol. 59, No. 1, p 55-70, 1989. 2 fig, 5 tab, 32 ref, append.

Descriptors: *Water pollution effects, *Insecticides, *Macroinvertebrates, *Recolonization, *Riffles, Chlorpyrifos, Lethal limit, Arthropods, Mollusks, Annelids, Aquatic insects, Roding River, Species composition, England.

The impact of a major spillage of the insecticide 'Dursban' on the riffle macroinvertebrates along 19 km of the River Roding, Essex, is described. Five affected riffles and an upstream control were kick-sampled at approximately 10-wk intervals for 2 years following the spill, and the results are compared with species composition and relative abundance data collected from the same sites during the previous 6 years. Initial concentrations of the active ingredient, chlorpyrifos, in river water (up to 2.5 mg/l) exceeded the levels lethal to all the aquatic arthropods present by at least 10-fold, and this group of macroinvertebrates was eliminated. Mollusks and annelids, which are relatively tolerant of chlorpyrifos, survived. Since these groups already dominated the lowermost urban reaches, the impact of the spill was greatest further upstream, where reaches with a better water quality previously supported a more diverse and abundant arthropod fauna. Chlorpyrifos residues in water declined below 1 microgram/L within 11 weeks, but sediment within 5 km of the spillage site remained highly contaminated for considerably longer. Of 10 arthropod taxa previously common to all sites, chironomid larvae were first to recolonize affected reaches, 13 weeks after the spill. The isopod Asellus aquaticus was also quick to recover. Although other arthropods had recolonized most sites within 79 weeks, the coleopteran Oulimnius tuberculatus and the ephemeropteran Caenis moesta had failed to return to the lowermost reaches after 108 weeks. Downstream drift was probably the principal factor influencing the pattern of arthropod recolonization, with the location and aquatic fauna of tributary streams entering the affected reaches being particularly important. (Author's abstract)
W89-13020

DETERMINANTS OF DRINKING WATER QUALITY IN RURAL NICARAGUA.
Instituto Nicaraguense de Acueductos y Alcantarillados, Managua.
For primary bibliographic entry see Field 5B.
W89-13021

EFFECTS OF METHOXYCHLOR ON ZOOPLANKTON IN FRESHWATER ENCLOSURES: INFLUENCE OF ENCLOSURE SIZE AND NUMBER OF APPLICATIONS.
Canadian Centre for Toxicology, Guelph (Ontario).
K. R. Solomon, G. L. Stephenson, and N. K. Kaushik.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 8, p 659-669, 1989. 6 fig, 3 tab, 31 ref.

Descriptors: *Insecticides, *Zooplankton, *Toxicity, *Water pollution effects, Methoxychlor, Agricultural chemicals.

Methoxychlor was applied to zooplankton in 20, 100 and 1000 cu m enclosures at a nominal concentration of 20 microgram/L. Total dissipation was more rapid than expected in the 20 cu m enclosures (slope=-0.0288) while rates in the 100 and 1000 enclosures were similar (slope=-0.0207 and -0.0187, respectively). Effects on zooplankton were less rapid and less severe and recovery more rapid in the 20 cu m than in the larger enclosures, but little difference was observed between the 100 and 1000 cu m enclosures. Comparison of a single application of 20 microgram/L in 100 cu m enclosures with two applications of 10 microgram/L, 35 days apart, also in 100 cu m enclosures, showed a more rapid dissipation after the first application than after the second (slope=-0.0236 vs. -0.0161). Acute toxic effects were not observed after the second treatment, and little effect on time to recovery was noted. Selection of certain species by the second application of methoxychlor was not observed. (Author's abstract)
W89-13022

TOXICOLOGY OF SYNTHETIC PYRETHROIDS IN AQUATIC ORGANISMS: AN OVERVIEW.
Iowa State Univ., Ames. Dept. of Entomology.
J. R. Coats, D. M. Symonik, S. P. Bradbury, S. D. Dyer, and L. K. Timson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 8, p 671-679, 1989. 3 fig, 1 tab, 59 ref. EPA grant 810659.

Descriptors: *Insecticides, *Toxicity, *Fish, *Aquatic insects, *Mosquito larvae, *Water pollution effects, Pyrethroids, Bioaccumulation, Reviews, Agricultural chemicals.

The aquatic toxicology of the photostable synthetic pyrethroid insecticides as it affects two groups of susceptible organisms, fish and aquatic insects, is discussed. The sensitivity of these aquatic species to the pyrethroids depends on several factors, including toxicokinetics, target site (nervous system), sensitivity and possible secondary mechanisms of action, as well as chemical and physical properties of the aquatic medium that influence toxicity and bioavailability. Uptake rates and routes of fenvalerate greatly affected the toxicity of fenvalerate to mosquito larvae. LD50 values were determined for cuticular and dietary exposure routes by utilizing radiolabeled fenvalerate at the respective LC50 concentrations in the two media (water and food). Fenvalerate was 6-fold more toxic to mosquito larvae by the cuticular route. Technical fenvalerate was more toxic to larvae than was the emulsifiable concentrate formulation. Addition of different concentrations of humic acid to the water reduced the toxicity to the larvae. Review and analysis of relevant literature are integrated into a discussion of the principles and details of aquatic toxicology of the pyrethroids. (Author's abstract)
W89-13023

METHODS FOR GROWTH INHIBITION TOXICITY TESTS WITH FRESHWATER ALGAE.
Vandkvalitetsinstitutet, Hoersholm (Denmark).
For primary bibliographic entry see Field 5A.
W89-13024

EFFECT OF SEDIMENT ORGANIC CARBON ON SURVIVAL OF HYALELLA AZTECA EXPOSED TO DDT AND ENDRIN.
Corvallis Environmental Research Lab., OR.
A. V. Nebeker, G. S. Schuytema, W. L. Griffis, J. A. Barbitta, and L. A. Carey.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 8, p 705-718, 1989. 4 fig, 8 tab, 30 ref.

Descriptors: *Insecticides, *DDT, *Endrin, *Toxicity, *Sediments, *Amphipods, *Water pollution effects, Hyalella, Organic carbon, Agricultural chemicals, Adsorption, Solubility, Median tolerance limit.

Sediment toxicity tests were conducted with the freshwater amphipod Hyalella azteca using sediments ranging in total organic carbon (TOC) concentration from 3-11% and spiked with either DDT or endrin. While the toxicity in the DDT-spiked sediment decreased with increasing TOC content, the TOC content of the endrin-spiked sediment had little apparent effect on toxicity. The 10-day sediment dry weight LC50 for DDT was 11.0 microgram/g at 3.0% TOC and 49.7 microgram/g at 10.5% TOC. The sediment dry weight LC50s for endrin at 3.0 and 11.2% TOC were 4.4 and 6.0 microgram/l, respectively. These results are important in evaluating the carbon normalization theory, which assumes that the availability of nonpolar organic compounds is reduced in the presence of higher concentrations of TOC. The differences in adsorption and toxicity between DDT and endrin are presumably related to the smaller carbon and octanol/water partition coefficients of endrin. (Author's abstract)
W89-13025

ADAPTATION TO A QUATERNARY AMMONIUM SURFACTANT BY SUSPENDED MICROBIAL COMMUNITIES IN A MODEL STREAM.
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
R. J. Shimp, B. S. Schwab, and R. J. Larson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 8, p 723-730, 1989. 3 fig, 4 tab, 22 ref.

Descriptors: *Surfactants, *Biodegradation, *Microbial degradation, *Fate of pollutants, *Adaptation, *Acclimatization, Dodecyltrimethylammonium chloride, Model streams, Adaptation.

The adaptation of suspended microbial communities to a quaternary ammonium surfactant, dodecyltrimethylammonium chloride (C-12TMAC), was studied in a model stream dosed with the surfactant. Water collected at several sites downstream of the introduction of C-12TMAC was tested for the ability of the suspended microbial community to biodegrade the surfactant and several naturally occurring chemicals. At the concentrations tested, C-12TMAC had no significant impact on the total size of the microbial community or its ability to degrade natural materials (glucose or amino acids). However, the ability of the community to degrade C-12TMAC increased by 10-fold to 1000-fold during exposure at all locations downstream from the dose site. After prolonged exposure, the C-12TMAC-degrading microbial community also developed a resistance to 'shock loads' of the surfactant (i.e., adaptation was maintained even when input concentrations were increased to levels that previously decreased biodegradation activity). Adaptation was a stable process as long as some quantity of C-12TMAC entered the stream. However, when input of surfactant was halted, the microbial community lost its ability to rapidly degrade the material. Upon redosing the stream with a low concentration of the chemical, the microbial community rapidly regained its enhanced biodegradative activity toward C-12TMAC. These results indicate the importance of adaptation in determining the fate of synthetic chemicals in aquatic environments. (Author's abstract)
W89-13027

EFFECT OF SUPPLEMENTARY DIETARY COPPER ON COPPER AND METALLOTHIONEIN LEVELS IN THE FISH, DAB, LIMANDA LIMANDA.
Institute of Marine Biochemistry, Aberdeen (Scotland).
For primary bibliographic entry see Field 5A.
W89-13039

SENSITIVITY DIFFERENCES BETWEEN EGGS AND LARVAE OF WALLEYE POLLOCK (THERAGRA CHALCOGRAMMA) TO HYDROCARBONS.
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
M. G. Carls, and S. D. Rice.
Marine Environmental Research MERSDW, Vol. 26, No. 4, p 285-297, 1988. 3 fig, 4 tab, 30 ref.

Descriptors: *Fish eggs, *Larvae, *Oil pollution, *Hydrocarbons, *Toxicity, *Water pollution effects, Walleye pollack, Theragra, Toluene, Naphthalene, Bioaccumulation, Mortality.

Exposure of embryonic and larval walleye pollock (Theragra chalcogramma) to the water-soluble fractions (WSF) of Cook Inlet crude oil during embryonic development caused mortality and a variety of morphological abnormalities. Median WSF concentrations (1.8 ppm) which caused mortality after hatch did not differ significantly from those causing morphological abnormalities (1.6 ppm). Pollack larvae exposed to WSF did not develop abnormalities, but swimming and survival were significantly affected within 4 h of exposure. The LC50 for larvae dropped from 1.9 ppm on day 4 to 0.9 ppm on day 10. The tissue of developing pollock larvae accumulated significantly more dissolved toluene and naphthalene than those of embryos. Consequently, when exposed to equal concentrations of WSF, larval tissues are exposed to much higher hydrocarbon concentrations than embryonic tissues. On the basis of internal tissue concentrations, larvae were less sensitive than eggs,

but the opposite conclusion is reached if external (WSF) concentrations are used for estimation of sensitivity. (Author's abstract)
W89-13042

PRELIMINARY STUDY OF IDIOPATHIC LESIONS IN THE DUNGENESS CRAB, CANCER MAGISTER,FROM ROWAN BAY, ALASKA.
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
J. F. Morado, A. K. Sparks, and C. E. O'Clair.
Marine Environmental Research MERSDW, Vol. 26, No. 4, p 311-318, 1988. 3 fig, 2 tab, 15 ref.

Descriptors: *Crabs, *Water pollution effects, *Logging, *Toxicity, Shell disease, Rowan Bay, Alaska, Crustaceans.

Dungeness crabs, Cancer magister, near a Log Transfer Facility (LTF) in Rowan Bay, Kuiu Island, southeast Alaska, were observed to have extensively eroded arthrodial membranes and darkened dactyl segments. The majority of crabs, 82%, had limb joint erosion in contrast to crabs tested from a reference station, of which 44% exhibited this symptom. The incidence of joint erosion was significantly different between sites ($P<0.05$). All crabs from both locations possessed blackened dactyls. Granulomas were the most common histopathological lesion observed in tissues from both stations, being found in 76% of LTF crabs and 33% of reference crabs. The prevalence of these lesions was significantly different between the two stations (Fischer's, $P<0.05$). They occurred in almost all organs and tissues, but were most prevalent in the gills, hindgut, heart and connective tissue of the hepatopancreas. The Mann-Whitney test applied to the granuloma data indicated that the general severity between the two stations was significant ($P<0.05$). The severity of lesions in the gills, hindgut and heart between the two stations was also significant ($P<0.05$). Melanized nodules were also observed in the majority of organs and tissues. No significant difference in prevalence was evident between either station, nor was there a significant difference in general severity. However, the severity of the lesion in the gills was significant (Mann-Whitney, $P<0.05$) between the two stations. It is suggested that toxic chemicals produced during the decomposition of organic debris resulting from LTF operations may have contributed to the production of the described lesions. (Sand-PTT)
W89-13043

ENVIRONMENTAL HAZARD OF EIGHT CHEMICALS PRESENT IN THE RHINE RIVER.
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
For primary bibliographic entry see Field 5A.
W89-13058

COMPUTERIZED DEGREE OF HAZARD ASSESSMENT FOR EVALUATION OF WASTES: AN INNOVATIVE AID TO THE MANAGEMENT OF RESIDUALS.
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5E.
W89-13059

HAZARD ASSESSMENT OF WASTEWATER DISCHARGES - A CONFLUENCE OF BIOLOGICAL AND PHYSICAL PARAMETERS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
For primary bibliographic entry see Field 5E.
W89-13063

CHANGES IN LAKE ECOSYSTEMS CONNECTED WITH THE POWER-GENERATING INDUSTRY (THE OUTLINE OF PROBLEM): THE KONIN LAKES (POLAND) AS THE STUDY SITES.
Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
A. Hillbricht-Ilkowska, and B. Zdanowski.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 5-21, 1988. 84 ref.

Descriptors: *Limnology, *Poland, *Thermal pollution, *Water pollution effects, Thermal powerplants, Konin Lakes, Heated water, Thermal stratification, Reservoirs, Aquatic habitats, Ecosystems, Long-term studies, Seasonal variation, Lake fisheries.

Causes in variation in aquatic ecosystems resulting from the heated discharge of power plants are reviewed. The discussion is restricted to the ecosystems of natural lakes and reservoirs of the temperate zone. The changes induced by a power plant are very diverse and highly specific in relation to the actual local environment conditions in the water body, climatic conditions, and mode of operation of the power plant. The main directions of these changes are as follows: (1) formation in the water body of a new thermal environment, with a different short-term cyclicity and seasonality and a marked horizontal thermal zonality; (2) a variable amount of intensification of production, consumption, and organic matter decomposition processes that in turn lead to disturbances in cycling of matter through food chains of pelagic and littoral zones; (3) formation of a new temporal and spatial arrangement of water mass mixing in the lake, with a scale of influence that wider than that of the thermal regime alone; (4) input (direct or with watershed waters and precipitation) of various contaminants (e.g., toxic substances, compounds that increase salinity, or hardness substances) that accelerate or modify lake eutrophication; (5) secondary changes in a lake ecosystem brought about by some fishery practices (e.g., introduction of thermophilous, herbivorous fish or elimination of native species); and (6) changes due to variation in the mortality of organisms (particularly fish) entrained in the cooling system of the power plant. The Konin lake system in Poland has functioned as an open cooling system for two power-generating and heat-generating plants since 1958. This area offers opportunities for studying many of the effects of power plant discharge. Studies, which began in 1956, have emphasized four main directions: long-term studies of whole-lake systems, seasonal effects, ecosystem structural changes, and fisheries studies. (See W89-13085 thru W89-13097) (Rochester-PTT)
W89-13084

MAIN CHANGES IN THE KONIN LAKE SYSTEM (POLAND) UNDER THE EFFECT OF HEATED-WATER DISCHARGE POLLUTION AND FISHERY.
Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
A. Hillbricht-Ilkowska, and B. Zdanowski.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 23-45, 1988. 5 fig, 6 tab, 34 ref.

Descriptors: *Poland, *Thermal pollution, *Water pollution effects, *Lake fisheries, *Limnology, *Eutrophication, Carp, Thermal powerplants, Konin Lakes, Heated water, Alkalinity, Nitrates, Phosphates, Carbonates, Sulfates, Iron, Retention time, Aquatic habitats, Ecosystems.

Five lakes near Konin, Poland, have been employed in as part of the cooling system for two heat-generating and power-generating plants since 1958. The location and limnological characteristics of these lakes are described and the main effects of power plant operations are considered. The range and intensity of effects of heated waters have varied in relation to the period of functioning of the whole lake system in the cooling process. In the first period (1958-1969), heated waters were discharged into three lakes (i.e., Lichenskie, Patnowskie, and the southern part of Mikorzynskie). In the second period (since 1970) the permanent cooling system also has included Lake Goslawskie and in summer Lake Slesinskie, so that in summer all five Konin Lakes are involved in the cooling process. The average water retention time in the second period (since 1970) has diminished several to more than 12-fold, amounting in summer to about 7 days for all lakes (range: 3-25 days for individual lakes). The discharge of mine waters and underground output also has become significant in the hydrologic budget of the lakes. The quantities of inorganic compounds brought with these waters, particularly NO3, PO4, Fe, Ca, CO3, SO4, and gases are high. Together with chimney dustfalls they constitute the cause of a constant rise of the concentration of inorganic compounds, of the alkaline reaction of the lake waters, and of a very high annual loading with P and Ca. This process can partially limit lake eutrophication by inactivating dissolved P (sorption) and depositing it (especially in the littoral) on sedimenting particles of calcium carbonate and loam. In summer, temperature differences in relation to natural conditions are 1 to 7 C. Significant disturbances in the seasonal cycle have been demonstrated (lack of ice cover, slower temperature rise in spring) and a permanent presence of thermal zonation now occurs in all lakes. The introduction of grass carp (and extinction of higher vegetation in two lakes) and silver carp was followed at first by an increase and then by a decrease in fish catches. A permanent change in the species composition of the catches has been observed. (See also W89-13084) (Rochester-PTT)
W89-13085

LONG-TERM VARIATION IN HABITAT AND TROPHIC FACTORS IN THE KONIN LAKES (POLAND) UNDER THE INFLUENCE OF HEATED-WATER DISCHARGE AND POLLUTION.
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
B. Zdanowski, A. Korycka, and A. Gebicka.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 47-77, 1988. 10 fig, 8 tab, 68 ref.

Descriptors: *Poland, *Thermal pollution, *Water pollution effects, *Seasonal distribution, *Eutrophication, Phosphorus, Nitrogen, Dissolved oxygen, Thermal powerplants, Konin Lakes, Heated water, Conductivity, Retention time, Primary productivity, Denitrification, Precipitation, Aquatic habitats, Ecosystems.

On the basis of 20 yr of investigations, trends in habitat conditions and trophic level of the five Konin Lakes (Poland) are described. The thermal and hydrologic regime of these lakes has been affected by power plant operations since 1958. Deformations in seasonal dynamics of oxygen concentrations were observed as well as higher concentrations of mineral salts and electrical conductivity, maintenance of a permanent alkaline reaction of the water, and lower abundance in the lakes of phosphorus and nitrogen compounds. The discharge of heated waters in 1965-1969 increased water temperature in Lake Lichenskie by about 7 C and in Lake Mikorzynskie by about 1.6 C. When all the lakes were joined in 1970 as part of the cooling system, the water retention of the lakes decreased as did the thermal gradient between the lakes. Mean temperatures of water in summer oscillated around 27 in Lake Lichenskie, 25 C in Lake Patnowskie, and 23-24 C in the other lakes. In lakes influenced by strong and constant heating, the seasonal cycle of changes in oxygen content was deformed. The increase in oxygen content in the epilimnion in the winter-spring period took place earlier than in other lakes and a much lower oxygen concentration was observed in summer. The changes were due to shifting of the primary production peaks to spring and activation of decomposition at lower production levels in the remaining periods. In the last few years a general decrease in abundance of N and P in the lakes has been observed. Apart from low water retention, which may inhibit the eutrophication of lakes, N denitrification and P precipitation in apatite compounds seem to be mainly responsible for the decreasing lake fertility. The precipitation of calcium carbonates immobilizes the entire annual P loading and part of the autochthonous pool of this element. (See also W89-13084) (Rochester-PTT)
W89-13086

LONG-TERM AND SEASONAL CHANGES IN THE PRIMARY PRODUCTION AND DESTRUCTION IN HEATED LAKES NEAR KONIN (POLAND).

Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
B. Zdanowski.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 79-95, 1988. 1 fig, 8 tab, 40 ref.

Descriptors: *Limnology, *Poland, *Thermal pollution, *Water pollution effects, *Eutrophication, Decomposition, Primary productivity, Thermal powerplants, Mixing, Chlorophyll, Seasonal distribution, Konin Lakes, Heated water, Long-term studies, Aquatic habitats, Ecosystems.

Directional, long-term trends of changes in primary production and decomposition in three heated lakes in the Konin Lakes system of Poland are described. The Konin Lakes have been affected by heated discharge for two power plants since 1958. Primary production decreased as the result of lower water retention in lakes and smaller abundance of nutrients. The studies were conducted between 1966 and 1983 on Lakes Lichenskie and Mikorzynskie and from 1975 also on Lake Goslawskie. Environmental conditions in the lakes have been described elsewhere. During the period 1966-1969 the heated Lake Lichenskie showed almost twice the productivity of the unheated (at that time) Lake Mikorzynskie. When in 1970 all the lakes of the Konin system became involved in power plant cooling, productivity in spring and summer decreased and Lake Lichenskie and increased in Lake Mikorzynskie. Lake Goslawskie had production indices typical of shallow, intensively mixed lakes. Production of this lake in the vegetation seasons of 1975-1978 was lower than in the remaining lakes. Different seasonal dynamics of chlorophyll and primary production were observed in the three lakes in 1978 despite a great similarity of the lakes in terms of water chemistry and nutrient abundance. Frequently, different thermal and mixing conditions were the factors differentiating the production of particular lakes. The effect of heating was mainly apparent in spring and early summer at lower water temperature ranges. Water flow in the lakes decreased the primary production and prevented the occurrence of algal blooms. (See also W89-13084) (Rochester-PTT)
W89-13087

CHANGES IN THE COMPOSITION AND QUANTITATIVE RELATIONS OF THE PHYTOPLANKTON IN HEATED LAKES NEAR KONIN (POLAND).

Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
A. T. Simm.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 97-113, 1988. 5 fig, 3 tab, 33 ref.

Descriptors: *Limnology, *Poland, *Thermal pollution, *Water pollution effects, *Phytoplankton, Chlorophyta, Diatoms, Biomass, Retention time, Rivers, Water currents, Eutrophication, Thermal powerplants, Konin Lakes, Heated water, Thermal stratification, Aquatic habitats, Ecosystems.

Phytoplankton was studied in four lakes of the Konin Lakes system (Poland). The Konin Lakes have been influenced by heated water discharge from power plants, which began in 1958. The four lakes studied were Lichenskie (153.6 ha, mean depth 4.9 m, max. depth 13.3 m), Slesinskie (148.1 ha, mean depth 7.5 m, max. depth 25.7 m), Milorzynskie (245.3 ha, mean depth 11.9 m, max. depth 38 m), and Goslawskie (378.9 ha, mean depth 1.3 m, max. depth 3.0 m). In the first years of operation of the cooling system, diatom phytoplankton biomass increased and fluctuated. Since the second half of the 1970s, the biomass has decreased and phytoplankton composition has become more homogeneous. At present (after 15-20 yr), the phytoplankton diversity is greater and green algae predominate. The decrease in phytoplankton biomass (based on cell shape) may be because of the change from diatoms, which are filled 90% with vacuole, to green algae, which have more cytoplasm in the cell. The fast cycling of cooling waters through the system resulted in a homogeneous trophic state and phytoplankton composition resembling more the phytoseston of highly eutrophic rivers of the temperate zone. (See also W89-13084) (Rochester-PTT)
W89-13088

LONG-TERM CHANGES IN THE COMPOSITION, PRODUCTIVITY AND TROPHIC EFFICIENCY IN THE ZOOPLANKTON COMMUNITY OF HEATED LAKES NEAR KONIN (POLAND).

Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
A. Hillbricht-Ilkowska, J. Ejsmont-Karabin, and T. Weglenska.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 115-144, 1988. 5 fig, 7 tab, 27 ref.

Descriptors: *Poland, *Thermal pollution, *Water pollution effects, *Limnology, *Zooplankton, Waterfleas, Rotifers, Entrainment, Mortality, Feeding rates, Reproduction, Predation, Fish, Current effects, Thermal powerplants, Mixing, Konin Lakes, Heated water, Aquatic habitats, Long-term studies, Ecosystems.

Secondary productivity was investigated beginning in 1966 in three of the five lakes of the Konin Lakes, Poland (Lake Lichenskie, Lake Slesinskie, and Lake Wasosko-Mikorzynskie). At first only Lake Lichenskie was affected by the heated discharge from power plants (beginning in 1958), but since 1970 all the lakes were part of the cooling system. In the three lakes, intensive mixing and heating has been associated with the following tendencies: a dominance of small forms (particularly rotifers), an increase in the relative production, and an analogous changes in their predators (carnivorous cyclopoids), retreating and production decrease of filter-feeding cladocerans, reduction in individual body size of all crustaceans and in increase in fecundity of most zooplankton species. The possible causes of these changes include turbulence, entrainment mortality, fish predation pressure, and abundance of detritus. The composition and quantitative relations of the zooplankton result from differences in the resistance to various eliminating factors (continual 'thinning' of the population due to mechanical factors, and fish pressure) and varying rates of population growth in turbulent and warm waters. These conditions favor the dominance and high productivity of smaller forms, especially rotifers, and their invertebrate predators. The efficiency of this link is always high. (See also W89-13084) (Rochester-PTT)
W89-13089

EFFECT OF HEATED-WATER DISCHARGE IN THE KONIN LAKES (POLAND) ON THEIR ICHTHYOFAUNA.

Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Dept. of Ichthyology.
H. Wilkonska.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 145-163, 1988. 6 fig, 2 tab, 71 ref.

Descriptors: *Limnology, *Poland, *Thermal pollution, *Water pollution effects, *Fish, Thermal powerplants, Konin Lakes, Heated water, Aquatic habitats, Reproduction, Water currents, Ecosystems, Fish populations, Pike, Rudd, Tench, Chub, Roach, Succession, Parasites, Predation.

Twenty years of studies of the responses of fish to heated discharge from power plants are reported. The Konin Lakes system (5 lakes, in Poland) has received heated discharge since 1958. Lake Lichenskie was the only lake receiving effluents when the study began in 1966. In 1968 Lake Goslawskie received discharge from a new power plant and its water level was increased by 1 m. In the period of 1970-1975, Lake Goslawskie became permanently joined to the cooling-water system, the heated discharge to Lake Lichenskie doubled, and a channel releasing heated water into Lake Slesinskie began to work (May and September heating only). During the period 1976-1980 the thermal and hydrobiological changes stabilized and became more constant. Since 1980 conditions have been relatively stable, thus revealing the long-term effects of heating on the lake fish communities. One of the first reactions of fish to a longer vegetation season is the accelerated growth rate of individuals and fry. At the same time, sexual maturity has been attained 2-3 yr earlier and fecundity has increased. Spawning not only begins earlier, but the fish are much younger, thus increasing their natural mortality. Analysis of the qualitative-quantitative structure of the fry has shown the withdrawal of typical psychrophilic species (pike) and lower numbers of philothermal standing water species (rudd, tench), which are replaced by chub (philocurrent species) and roach, which have long-term plasticity. The general trend of decreasing fry numbers shows the negative effects of long-term heating. Reproduction conditions are worse (lack or destruction of spawning grounds) and the influence of higher temperatures on the development cycle of gonads, quality of sexual products, embryonic and post-embryonic development or condition of parents. Such factors as current, parasites, predation, and water pollution are significant. (See also W89-13084) (Rochester-PTT)
W89-13090

SPATIAL PATTERN OF TEMPERATURE, OXYGEN AND NUTRIENT CONCENTRATION IN TWO LAKES OF DIFFERENT HEATED-WATER DISCHARGE SYSTEMS.

Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
A. Hillbricht-Ilkowska, and A. T. Simm.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 165-182, 1988. 5 fig, 8 tab, 8 ref.

Descriptors: *Poland, *Thermal pollution, *Water pollution effects, Thermal powerplants, Konin Lakes, Lake Slesinskie, Lake Goslawskie, Dissolved oxygen, Phosphorus, Nitrogen, Organic matter, Thermal stratification, Comparison studies, Retention time, Heated water, Aquatic habitats, Ecosystems.

The Konin Lakes (Poland) have been used in cooling the discharge from power plants since in 1958. The entire lake system (5 lakes) has been affected by cooling water discharge since the 1970s. Heated waters discharged in summer through a waterfall into the deep and morphometrically diverse Lake Slesinskie caused a considerable reduction in the water retention (to 5-6 days), diversification of the habitat conditions in certain parts of the lake, an increase in total P and organic and ammonia N loading of the lake, an increase in the concentration of these elements, particularly in the near-bottom layers, and an increase in soluble Si in the surface layer. Heated waters discharged through a spillway into the shallow and round-shaped Lake Goslawskie cause a marked thermal zonation, with thermal stratification persisting only in the part of the lake close to the discharge, and no direct changes in oxygen and nutrient concentration in the water mass at a water retention times ranging from 2-3 days. It is concluded that the deepest lakes in the Konin system, and their deepest parts, can function as 'traps' that accumulate the P transported within the cooling system and imported from outside, whereas the shallow lakes with a short retention time serve mainly to transport nutrients. (See also W89-13084) (Rochester-PTT)
W89-13091

SPATIAL DISTRIBUTION OF THE PHYTOPLANKTON IN TWO LAKES IN RELATION TO THE THROUGH-FLOW OF HEATED WATERS.

Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
A. T. Simm.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 183-202, 1988. 8 fig, 2 tab, 33 ref.

Descriptors: *Poland, *Thermal pollution, *Water pollution effects, *Limnology, *Phytoplankton, *Eutrophication, Thermal powerplants, Konin Lakes, Lake Slesinskie, Lake Goslawskie, Retention time, Rivers, Biomass, Heated water, Aquatic habitats, Ecosystems, Spatial distribution, Long-term studies, Comparison studies, Seasonal distribution, Species diversity.

The Konin Lakes (Poland) have been used in cooling the discharge from power plants since in 1958. The entire lake system has been affected by cooling water discharge since the 1970s. Lake Slesins-

kie receives heated discharge for 6 mo/yr, whereas Lake Goslawskie receives heated discharges year-round. In both lakes, after the spring blooms of centric diatoms (10-21 mg/cu dm), the biomass in summer decreases to 1-2 mg/cu dm and green algae, xanthophytes, dinoflagellates, and cryptomonads dominate. Heating increases decomposition and accelerates seasonal succession of phytoplankton. The main post-discharge current in Lake Slesinskie has species found in eutrophic rivers, whereas in the region of water cooling and downwelling, buoying species (blue-green algae and large dinoflagellates) assemble. Because of low water retention in Lake Goslawskie, the diatoms occur abundantly, even in summer. At the end of the 1970s a higher biomass was recorded in Lake Goslawskie than in Lake Slesinskie, but now the differences in biomass are not as great. Phytoplankton concentration in Lake Goslawskie is much lower. Summer biomass of phytoplankton has decreased in both lakes compared to spring biomass, but the species diversity and percentage of the community consisting of nannoplankton have increased in both lakes, possibly due to decreased pressure from phytophagous zooplankton. The variability of water flow rate in the Konin system, regions of downwelling, temperature differences, transition from strongly mixed and homogenous regions to stratified ones probably are the reasons why phytoplankton does not fully use the trophic resources of the lakes. Together with the presence of phytophagous zooplankton, sedimentation, and strong decomposition (high phaeophytin percentage) limit the development of algae. (See also W89-13084) (Rochester-PTT)
W89-13092

SPATIAL DISTRIBUTION OF THE ZOOPLANKTON AND ITS POPULATION FEATURES IN TWO LAKES OF DIFFERENT HEATED-WATER THROUGH-FLOW.

Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
J. Ejsmont-Karabin, and T. Weglenska.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 203-230, 1988. 11 fig, 4 tab, 35 ref.

Descriptors: *Poland, *Thermal pollution, *Water pollution effects, *Limnology, *Zooplankton, Lake Slesinskie, Lake Goslawskie, Rotifers, Crustaceans, Spatial distribution, Animal populations, Thermal powerplants, Konin Lakes, Heated water, Aquatic habitats, Comparison studies, Seasonal variation, Temporal distribution, Ecosystems.

The Konin Lakes (Poland) have been used in cooling the discharge from power plants since in 1958. The entire lake system (5 lakes) has been affected by cooling water discharge since the 1970s. Zooplankton populations were examined in two lakes affected by power plant cooling waters. Lake Slesinskie is stratified and heated temporarily with hot water discharged in a waterfall mode from a spring-board about 15 m high. Lake Goslawskie is polymictic, heated constantly with an overflow discharge from several spillways. Considerable changes in zooplankton community structure and function occurred in both lakes. For example, there was an earlier occurrence of summer forms and changed spatial distribution and species diversity in rotifer and crustacean communities in ways related to the discharge of heated waters and lake morphometry. It appears that the factors controlling the abundance and functioning of zooplankton communities in heated lakes are higher temperatures and the mictic state brought about by the discharge of heated waters. In addition to phenomena common to both lakes as a result of higher temperatures (directly or indirectly), such as the earlier occurrence of the summer zooplankton species or higher relative fecundity, there were some different responses between the two lakes. The seasonal heating of Lake Slesinskie causes rapid changes in zooplankton structure following the starting of the discharge and high zooplankton variation in the next period; horizontal diversity of habitats, and consequently structure of the zooplankton communities, also was increased as different parts of the lake became either mixed or stratified zones. The continuous heating of Lake Goslawskie and the overflow mode of heated water discharge favored narrower spatial and temporal variation in the zooplankton. (See also W89-13084) (Rochester-PTT)
W89-13093

ZOOPLANKTON LOSSES DURING THE PASSING THROUGH THE COOLING SYSTEM OF A POWER STATION.

Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
J. Tunowski.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 231-243, 1988. 2 fig, 5 tab, 29 ref.

Descriptors: *Poland, *Thermal pollution, *Water pollution effects, *Zooplankton, *Entrainment, Mortality, Crustaceans, Rotifers, Thermal powerplants, Konin Lakes, Heated water, Aquatic habitats, Ecosystems, Seasonal distribution.

The Konin Lakes (Poland) have been used in cooling the discharge from power plants since in 1958. The entire lake system (5 lakes) has been affected by cooling water discharge since the 1970s. The effects of two power plants were investigated. The Konin plant removes water from Lake Patnowskie and discharges it (via a canal) into Lake Lichenskie, which discharges into the upper end of Lake Patnowskie. The Patnow plant takes water for cooling from Lake Goslawskie (downstream of Lake Patnowskie) and returns part of it to Lake Goslawskie and part to Lake Lichenskie via a canal. The zooplankton losses in the cooling system of the cooling system of the Konin power plant were considerable: 37-80% of the biomass in summer and 97.5% in winter. The difference was due to the degree of heating of the cooling water, which rose by 9.2 C in winter and by 4-8 C in summer. The greatest losses were observed among Crustacea (80% in summer and almost 100% in winter), whereas for Rotatoria it was 55% in summer and 41% in winter. Losses of zooplankton in the cooling water system of the Patnow power plant in winter were small because the abundance of zooplankton is low in Lake Goslawskie. (See also W89-13084) (Rochester-PTT)
W89-13094

DISTURBANCES IN ZOOPLANKTON SEASONALITY IN LAKE GOSLAWSKIE (POLAND) AFFECTED BY PERMANENT HEATING AND HEAVY FISH STOCKING.

Polish Academy of Sciences, Mikolajki. Inst. of Ecology.
J. Ejsmont-Karabin, and T. Weglenska.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 245-260, 1988. 4 fig, 2 tab, 28 ref.

Descriptors: *Limnology, *Poland, *Thermal pollution, *Water pollution effects, *Fish populations, *Zooplankton, Carp, Lake Goslawskie, Seasonal variation, Long-term studies, Comparison studies, Thermal powerplants, Konin Lakes, Heated water, Aquatic habitats, Ecosystems, Succession, Rotifers, Crustaceans, Water currents.

The Konin Lakes (Poland) have been used in cooling the discharge from power plants since in 1958. The entire lake system (5 lakes) has been affected by cooling water discharge since the 1970s. This study was conducted to determine the effect of water heating and intensified feeding pressure by phytophagous fish (silver and bighead carps) on the abundance of species composition of zooplankton in Lake Goslawskie, a shallow lake receiving power plant cooling water. The study was conducted in 1978; Lake Goslawskie has been receiving heated water since 1969. Although the phytoplankton of the lake was relatively abundant, the numbers and biomass of zooplankton were not equally high. Comparison of zooplankton abundance in April, May, and July 1978 with records for the preceding and following years demonstrated that the zooplankton population was low initially and has been increasing with time. No fall in zooplankton abundance was recorded after the introduction of carps. A very characteristic feature of this lake was the replacement, form early spring onward, of typically cold-water species (spring species) by zooplankton typical of the summer period. This phenomenon was particularly marked in the case of rotifers. By 1978, three trophic groups were dominant; this represented a narrowing of the spectrum of food used by rotifers to mainly either detritus or small algae. A similar, but less distinct, change was noted for crustaceans. Overall the structure of the zooplankton community has become impoverished, seasonal variation has been reduced, trophic group diversity has narrowed, and body-size has been reduced. The three factors cited in these changes are water temperature rise, water flow acceleration, and introduction of carps. (See also W89-13084) (Rochester-PTT)
W89-13095

ABUNDANCE AND DISTRIBUTION OF THE MUSSEL DREISSENA POLYMORPHA (PALL.) IN HEATED LAKES NEAR KONIN (POLAND).

Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
A. Stanczykowska, K. Lewandowski, and J. Ejsmont-Karabin.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 261-273, 1988. 9 fig, 4 tab, 16 ref. Project PR-4 (Poland).

Descriptors: *Poland, *Thermal pollution, *Water pollution effects, *Limnology, *Mussels, Zooplankton, Thermal powerplants, Konin Lakes, Masurian Lakes, Larvae, Retention time, Heated water, Aquatic habitats, Animal populations, Ecosystems.

The Konin Lakes (Poland) have been used in cooling the discharge from power plants since in 1958. The entire lake system (5 lakes) has been affected by cooling water discharge since the 1970s. The occurrence of planktonic larvae of Dreissena polymorpha was analyzed in these lakes in relation to the amount of heated discharge they received. The larvae were found in all the lakes, presumably because the circulation of the water currents from one lake to another carry them. The period of occurrence of D. polymorpha in the plankton, lasting sometimes from March till the end of September, is almost twice as long as in other Polish lakes. The numbers of larvae in the epiliminion are of a similar order or slightly greater in the relatively unheated lakes. Long reproduction time and high production of larvae in the Konin Lakes are not accompanied by a greater density of D. polymorpha adults than in the unheated Masurian Lakes. This may be due to high through-flow of Konin Lakes, transporting considerable numbers of larvae to power plant or aluminum plant cooling systems. (See also W89-13084) (Rochester-PTT)
W89-13096

EFFECT OF THE INTRODUCTION OF HERBIVOROUS FISH IN THE HEATED LAKE GOSLAWSKIE (POLAND) ON THE FRY OF LOCAL ICHTHYOFAUNA.

Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Dept. of Ichthyology.
H. Wilkonska.
Ekologia Polska ELPLBS, Vol. 36, No. 1-2, p 275-281, 1988. 3 fig, 1 tab, 11 ref.

Descriptors: *Limnology, *Poland, *Thermal pollution, *Water pollution effects, *Fisheries, Carp, Fish, Lake Goslawskie, Thermal powerplants, Konin Lakes, Heated water, Aquatic habitats, Ecosystems, Long-term studies, Succession, Mortality, Fish stocking.

Lake Goslawskie (Poland) belongs to the Konin Lakes complex, five connected lakes some of which have been receiving power plant cooling water since 1958. Lake Goslawskie, a 379-ha water body of 2.6-1.3 m depth, began to receive cooling system water from the Patnow power plant in 1969. Changes in the fry complex were investigated before and after stocking the lake with silver carp (Hypophthalmichthys molitrix Val.) and bighead carp (Aristichthys nobilis Rich.). All fish species abundantly and frequently occurring in the lake, except Blicca bjorkna (L.) and Leuciscus (L.), decreased rapidly in numbers after stocking, whereas species sporadically caught (Cyprinus carpio L. and Carassius carassius (L.)) disappeared. The losses of fish are attributed first to the intense stocking with carps and to a smaller extent to the

changed environmental conditions resulting from heating. (See also W89-13084) (Rochester-PTT)
W89-13097

MANAGEMENT OF PHOSPHORUS AND NITROGEN INPUTS TO LAKE ROTORUA, NEW ZEALAND.
Department of Scientific and Industrial Research, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 5G.
W89-13124

CAESIUM-137 IN PERCH IN SWEDISH LAKES AFTER CHERNOBYL--PRESENT SITUATION, RELATIONSHIPS AND TRENDS.
Uppsala Univ. (Sweden). Dept. of Hydrology.
For primary bibliographic entry see Field 5B.
W89-13155

MULTIPLE TESTING APPROACH FOR HAZARD EVALUATION OF COMPLEX MIXTURES IN THE AQUATIC ENVIRONMENT: THE USE OF DIESEL OIL AS A MODEL.
National Fisheries Contaminant Research Center, Columbia, MO.
For primary bibliographic entry see Field 5A.
W89-13156

EFFECT OF SOME PESTICIDES ON IN-VITRO LIPID AND PROTEIN SYNTHESIS BY THE LIVER OF THE FRESHWATER TELEOST, CHANNA PUNCTATUS (BL).
Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology.
P. K. Saxena, V. P. Singh, J. K. Kondal, and G. L. Soni.
Environmental Pollution ENPOEK, Vol. 58, No. 4, p 273-280, 1989. 1 tab, 21 ref.

Descriptors: *Pesticides, *Water pollution effects, *Pesticide toxicity, *Fish, *Animal metabolism, *Liver, *Lipids, *Proteins, Fish populations, Growth, Synthesis, Environmental effects, Carbon radioisotopes, Malathion, Carbaryl.

Pesticides have been recognized as environmental pollutants of potential toxicological concern to fishes, as diagnosed by their acute toxicities. Sublethal concentrations of certain pesticides bring about biochemical changes in the liver, a major organ of xenobiotic metabolism. A decline in the lipid and protein levels in the liver of fishes, following exposure to pesticides indicates a reduced rate in their synthesis, or an enhanced mobilization. The synthesis rate may be diagnosed through the incorporation of labeled substances into lipids/proteins. In vitro incorporation of C-14-glucose/acetate into lipids and C-14-leucine into proteins by the liver of Channa punctatus, exposed to safe application rate (SAR) and sublethal (SL) concentrations of malathion and carbaryl for 30 days during the preparatory phase of the reproductive cycle, declined more in the fish exposed to SL concentrations than to SAR concentrations of the pesticides. The decline in incorporation was more marked in the malathion-exposed fish, than in those exposed to carbaryl. Hence, malathion is considered more toxic than carbaryl in inhibiting the de-novo synthesis of lipids and proteins by the liver. (Author's abstract)
W89-13157

SPONTANEOUS ABORTIONS IN RELATION TO CONSUMPTION OF TAP WATER: AN APPLICATION OF METHODS FROM SURVIVAL ANALYSIS TO A PREGNANCY FOLLOW-UP STUDY.
California Dept. of Health Services, Berkeley.
For primary bibliographic entry see Field 5F.
W89-13172

RELATIVE QUANTITIES AND HETEROTROPHIC ACTIVITIES OF FREE LIVING AND ATTACHED BACTERIA IN A EUTROPHIC LAKE (IMPORTANCE RELATIVE DES FRACTIONS BACTERIENNES LIBRES ET FIXEES EN MILIEU LACUSTRE EUTROPHIC LAKE).
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. de Zoologie.
O. Marvalin, L. Aleya, and C. Amblard.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 3, p 371-390, May 1989. 6 fig, 4 tab, 42 ref. English summary.

Descriptors: *Eutrophic lakes, *Limnology, *Bacteria, *Phytoplankton, *Lakes, Species composition, Diatoms, Chlorophyta, Cyanophyta, Lake Aydat, France.

As part of a study of eutrophic Lake Aydat, France, the relative quantities and heterotrophic activities of free living and attached bacteria in the water column were determined. Weekly samples were taken at several depths in both the trophogenic and tropholytic zones. Fixed bacteria represented 18-27% of the total bacterial abundance. Their heterotrophic activity was relatively more important, reaching 22-56% of the total heterotrophic activity. Both epibacterial abundance and heterotrophic activity were positively related to phytoplankton primary production, the major particle producer in the lake. However, both factors also depended on the physiological state and principal species composition of the phytoplankton. (Peters-PTT)
W89-13175

CHANGES IN SEASONAL SUCCESSIONS OF PLANKTON IN LAKE KVERNAVATN, COMPARED TO THE PEG-MODEL.
Bergen Univ. (Norway). Dept. of Microbiology and Plant Physiology.
For primary bibliographic entry see Field 2H.
W89-13177

SOME PECULIARITIES IN DEVELOPMENTAL BIOLOGY OF TWO FORMS OF THE FRESHWATER BIVALVE UNIO CRASSUS IN NORTHERN GERMANY.
Tieraerztliche Hochschule Hannover (Germany, F.R.). Inst. fuer Zoologie.
H. Engel, and K. Wachtler.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 3, p 441-450, May 1989. 7 fig, 1 tab, 18 ref.

Descriptors: *Limnology, *Ecology, *Mussels, *Mollusks, *Population dynamics, *West Germany, Streams, Fish.

The freshwater bivalve Unio crassus (Philipsson) is threatened with extinction in many parts of Germany. In the course of more detailed studies on its ecological requirements some regional peculiarities among Unio crassus populations in Northern Germany were observed. These peculiarities not only concern the well known variability in body size and shape of the shells but also the number of released glochidia and differences in the preference of the host fish. The results indicate that regional differences in its ecological requirements have to be taken into account whenever measurements for the protection of threatened Unio crassus populations are considered. Since Unio crassus is more selective in the choice of its host fish than other Unionids, it is likely that environmental changes affecting host fish ecology may be more destructive than direct effects of pollution. (Peters-PTT)
W89-13179

APPROACH FOR ASSESSING IMPACTS OF IN-PLACE CONTAMINATED SEDIMENTS ON WATER QUALITY.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W89-13256

DISTRIBUTION AND MOBILIZATION OF ARSENIC AND ANTIMONY SPECIES IN THE COEUR D'ALENE RIVER SYSTEM.
Idaho Univ., Moscow. Dept. of Chemistry.
C. M. Wai, and W. M. Mok.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-204440/AS. Price codes: A04 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, Moscow, Completion Report, May 1989. 54p, 17 fig, 13 tab, 31 ref. Contract 14-08-0001-G1222. Project USGS G1222-07.

Descriptors: *Groundwater pollution, *Mine wastes, *Idaho, *Arsenic, *Antimony, Coeur d'Alene River, Water pollution sources, Leachates, Path of pollutants.

The mining industry along the South Fork of the Coeur d'Alene River in northern Idaho is a major producer of silver, lead, and zinc in the United States. Mining operations in the past have discharged huge amounts of mining wastes into the South Fork of the river causing a serious pollution problem for the Coeur d'Alene River system. Sediments in the South Fork and the main stem of the river are contaminated with arsenic (As), antimony (Sb), cadmium (Cd), Lead (Pb), Zinc (Zn), and other metals. The North Fork water was found relatively uncontaminated and showed very low concentrations of As (<0.26 ng/mL) and Sb (<0.17 ng/mL). Water samples collected from the South Fork showed high levels of As (0.16-1.64 ng/mL) and Sb (1.11-8.25 ng/mL). Relatively lower concentrations of As (0.11-1.48ng/mL) and Sb (0.23-1.90 ng/mL) were found in the main stem of the river. Arsenic (III) was the predominant form of As in the South Fork and main stem, whereas the North Fork generally had a higher As (V) concentration in water. Antimony (V) was the major Sb species in the three branches of the river. Leaching of As and Sb from the sediments along the main stem depends on the pH of the water and on the iron and manganese content of the sediments. The amount of As and Sb leached was high in acidic or in basic solutions. The enhanced desorption of As and Sb in basic solutions was probably related to the anionic properties of these elements. An accumulation of As and Sb on the surface sediments were also observed in the delta area where the river enters Lake Coeur d'Alene. The releases of As and Sb from sediments appear to associate with the free iron oxides and manganese oxides in the sediments. The leaching characteristics of Sb are similar to those of As. However, releases of sediment Sb were generally found linear with respect to time while asymptotic limits on As releases were reached. Significant amounts of Zn, Fe, and Mn were also released during leaching, but Cu, Cd, Pb, and Ni were much less leachable. According to this study, interactions of water with the existing sediments is likely to be a major factor controlling the water quality of the Coeur d'Alene River. (USGS)
W89-13317

FISH DISEASES OF THE ALBEMARLE-PAMLICO ESTUARY.
North Carolina Water Resources Research Inst., Raleigh.
E. J. Noga, M. J. Dykstra, and J. F. Levine.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-204424/AS. Price codes: A05 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Completion Report No. 238, (UNC-WRRI-89-238), April 1989. 81p, 12 fig, 17 tab, 59 ref. Contract 14-08-0001-G1035; G1243. Project USGS G1243-04.

Descriptors: *Fish diseases, *Salinity, *North Carolina, Water quality, Fungi, Albermarle-Pamlico estuary, Menhaden, Agricultural runoff, Nutrient loading, Epidemiology, Pathogens, Fish physiology, Ulcerative mycosis.

Concern of fisheries managers over disease problems that appear in important sport and commercial fishes in the Tar-Pamlico Estuary was the impetus for this study. Through a monitoring program in the Tar-Pamlico River the investigators assessed the occurrence and species distribution of ulcerative mycosis. More than 70,000 fish representing 31 species were collected by trawling and with pound nets from May 1985 to April 1987 and by cast net during October-November 1986. Menhaden between 60-119 mm fork length were most commonly affected with UM: 15.7% of the menhaden collected by trawling were affected, with 100% of the fish in individual trawl samples affect-

ed at times. Although a few fish with lesiona were observed throughout the year, focused outbreaks reached epidemic proportions during May 1985 and November 1986. The posteroventral portion of the body was most frequently affected, with over 60% of all lesions observed in this area. Some factors predispose menhaden in the brackish water environment to severe infection by two freshwater fungi. The pathogenicity of the oomycetes in the estuarine system may be altered as well. The disease arose in epidemic proportions in the summer of 1984 when high precipitation levels had depressed salinity and high runoff from agricultural lands had loaded the Pamlico River with nutrients and large amounts of detritus. The relationship of the fungal isolates to the lesions found on fish and the association of prevailing climatological conditions with the disease suggest a complex interaction between the pathogens, the host fish, and the environment (especially salinity). (Lambert-UNC-WRRI)
W89-13319

USE OF STABLE CARBON AND NITROGEN ISOTOPES TO TRACE THE LARVAL STRIPED BASS FOOD CHAIN IN THE SACRAMENTO-SAN JOAQUIN ESTUARY, CALIFORNIA, APRIL TO SEPTEMBER 1985.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 8I.
W89-13349

5D. Waste Treatment Processes

WATER AND WASTEWATER TREATMENT FOR A SMALL ISLAND RESORT.
Queensland Inst. of Tech., Brisbane (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 3A.
W89-12228

ONSITE WASTEWATER TREATMENT AND DISPOSAL FOR COASTAL RESORT BUSINESSES.
Drexel Univ., Philadelphia, PA.
J. P. Martin, and K. J. Zitomer.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 199-204, 1989. 3 fig, 6 ref.

Descriptors: *Wastewater treatment, *Wastewater disposal, *Nitrates, *Organic compounds, Nitrogen removal, Recreation, Tourism.

Onshore commercial or institutional services for the New Jersey barrier island resorts frequently dispose of wastewater onsite, by percolating septic system effluent to the underlying aquifers. However, to protect the groundwater supplying potable water and brackish wetlands, larger onsite systems must now include advanced treatment to remove nitrates. Effluent produced by a mechanical treatment plant at a new nursing home was improved by percolation through a zoned sand mound disposal bed, but operation of the small but complex plant is expensive. Therefore, another system to remove organics and nitrogen was developed for a shopping center, which was expected to have severe seasonal variations in wastewater quality and quantity. Treatment in a series of in-ground and mounded aerobic and anoxic units provides operational economy and flexibility appropriate to resort area commercial establishments. (Author's abstract)
W89-12230

CRITERIA FOR SEWAGE TREATMENT AND DISPOSAL IN A TOURIST CITY.
Gold Coast City Council (Australia). Planning and Design.
J. L. King.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 255-259, 1989. 2 ref.

Descriptors: *Wastewater treatment, *Wastewater disposal, *Tourism, *Recreation, *Water quality standards, Australia, Design criteria.

The design criteria used by the Gold Coast City Council in the design of its sewage treatment and disposal system are discussed. Tourism is the city's major industry and the city's raw sewage is almost completely domestic in its nature. The quantity and quality of the raw sewage are discussed and parameters defined for treatment. Unpolluted beaches and waterways are an essential part of the tourism image and the effluent standards required by the Water Quality Council of Queensland and the method of disposal and effluent standards adopted by the City Council are discussed. The city has opted for a higher standard of effluent from its two major treatment plants than that required under its license because of the tourist industry's dependence on pollution free waterways. (Sand-PTT)
W89-12239

IMPACT OF LAGOON EFFLUENT ON AN INLAND STREAM: A 10 YEAR PERSPECTIVE.
WSL Consultants Pty Ltd., Richmond (Australia).
For primary bibliographic entry see Field 5E.
W89-12244

ADVANCING COMPUTERIZED PLANNING FOR WASTEWATER COLLECTION.
Camp, Dresser and McKee, Inc., Walnut Creek, CA.
P. R. Giguere.
Water Engineering and Management WENMD2, Vol. 136, No. 4, p 24-27, April 1989. 5 fig.

Descriptors: *Wastewater collection, *Sewer systems, *Computer models, *Computer programs, *Management planning, Databases, Computer programs, Costs.

Computers and computer models have been used for years to assist analysis and planning of wastewater collection systems. While the early computer programs easily performed all the necessary computations of pipe flows and capacities, they tended to be difficult to use for engineers lacking a strong background in computers and modeling, and as a result the models did not have widespread use for collection system planning studies. The development of personal computers in the last decade has provided faster and less expensive microcomputers and powerful user-oriented software to engineers and planners. Of particular significance to sewer system planning models is the recent availability of advanced database languages and computer aided drafting (CAD) software which have expanded capabilities and simplified the modelling process and CAD software in the latest version of its model. Wastewater agency staffs are using systems like Sewer Network Analysis Program (SNAP), a computer-based sewer system model, which incorporates database and CAD software, in-house as day-to-day decision making tools. The computer system's efficiency allows more conditions to be analyzed and better solutions to be visualized and tested, resulting in reduced overall capital costs. (Sand-PTT)
W89-12246

CONTRACT OPS AND CAPITAL IMPROVEMENTS BOOST PUMP STATION EFFICIENCY.
Oklahoma City Director of Utilities, OK.
J. Couch, and D. Merrill.
Water Engineering and Management WENMD2, Vol. 136, No. 4, p 28-30, April 1989.

Descriptors: *Wastewater facilities, *Municipal wastewater, *Pumping plants, *Contracts, *Operating costs, *Cost analysis, *Capital improvements, Computers, Telemetry.

There is a growing use of contract operations of municipal wastewater plants by the public works community. In most agreements of this type, a municipality contracts a private firm to operate its facility 'as is.' In a novel contract operations agreement by Oklahoma City, the city's request for proposal (RFP) directed prospective contractors to conduct on-site inspections at the wastewater facilities. The contractors were to identify and allow for any operational changes and/or capital improvements necessary to ensure that the facilities would be operated in the most efficient and cost-effective manner. Oklahoma City's progressive RFP for contract operations services resulted in innovative techniques in operating and maintaining its three wastewater treatment plants, a large pumping station, and providing sludge disposal services, with an estimated $4.9 million annual savings in operating costs. A good example of this municipality's committment to improving the operational and cost efficiencies of its wastewater system can be found at the Witcher Pumping Station. This facility has undergone extensive operational and mechanical improvements by the private firm contracted, including the installation of a computer-based telemetry system, an upgrading of the control system, and the implementation of a more efficient staffing plan. (Sand-PTT)
W89-12247

WHICH WAY TO CONTROL PUMP STATIONS.
Metropolitan Water Reclamation District of Greater Chicago, IL. Calumet Water Reclamation Plant.
M. E. Hannigan.
Water Engineering and Management WENMD2, Vol. 136, No. 4, p 36-38, April 1989.

Descriptors: *Wastewater facilities, *Pumping plants, *Technology, Remote control.

Pump stations for handling wastewater can be run with the latest technology. With the advent of remote control, most if not all major adjustments can be made much more easily, eliminating much of the overhead cost to operate these facilities. However, the new technologies may often be accompanied by their own sets of problems. These include the operating costs of the new instrumentation and their sensitivity to physical and environmental effects such as humidity, vibration, oxidation due to corrosive atmospheres, dust, etc. These problems are discussed with respect to the newer technology. Suggestions on how to mix the old and the new technology in the control of pump stations include placing all electronic equipment in a hermetically sealed box, heating the interior to 70F, and sealing all conduits feeding the box. The addition of time pulse-to-current, ac-to-dc, and analog-to digital converters to the sealed box will result in a system that will give accurate readings and updated pump control capacity. (Sand-PTT)
W89-12248

USE OF WATER TEST-ORGANISMS IN WASTE-DERIVED ALUMINUM SULFATE TOXICITY STUDIES IN VIEW OF ITS UTILIZATION AS A COAGULANT IN WASTE WATER TREATMENT (IZPALZVANE HA VODNI TEST-OBEKTI PRI ISLEDRANE TOKSICHNOSTTA NA ALUMIMEV SULFAT, POLYCHEN OT OTPAD CHNI PRODUKTI, S OGLED PRILAGANETO MI KATO KOAGULANT PRIPRECHISTVANE HA OTPAD' RDNI VODI(IN BULGARIAN).
Napravlenie Nauchno-Tekhnologihni Izsledvaniia Pri Kompleksniia Nauchno-Izsledovatelski i Proektantski Institut po Blagoustroistva i Komunalno Stopanstvo, 1618 Sofia (Bulgaria).
For primary bibliographic entry see Field 5A.
W89-12260

ANAEROBIC DIGESTION OF A PETROCHEMICAL EFFLUENT USING AN ANAEROBIC HYBRID DIGESTER.
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Microbiology.
M. T. Augoustinos, T. J. Britz, and R. P. Tracey.
Biotechnology Letters BILED3, Vol. 11, No. 5, p 369-374, May 1989. 1 tab, 17 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Anaerobic digestion, *Industrial wastewater, *Oil wastes, Chemical oxygen demand, Fatty acids, Ammonia, Nitrogen, Phosphates, Biogas, Methane, Petrochemicals, Oil industry.

An anaerobic hybrid reactor was used in the anaerobic treatment of an acidic petrochemical effluent. An organic loading rate of 20.02 kg COD/cu m/d at a HRT of 17 hours was obtained with a volatile fatty acid removal of 91%, and COD removal of 84%. A final reactor effluent containing 44 mg/L ammonia nitrogen and 12.3 mg/L phosphate phosphorus was produced. (Author's abstract)
W89-12294

ANAEROBIC TREATMENT OF PULP AND PAPER MILL WASTEWATERS.
CH2M/Hill, Bellevue, WA.
J. W. Lee, D. L. Peterson, and A. R. Stickney.
Environmental Progress, Vol. 8, No. 2, p 73-87, May 1989. 11 fig, 10 tab, 42 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Anaerobic digestion, *Industrial wastewater, *Pulp wastes, Pulp and paper industry, Waste characteristics, Anaerobic lagoons, Fluidized bed process.

Application of anaerobic treatment is rapidly gaining acceptance in the pulp and paper industry. Since 1983, with successful start-up and operation of the first high-rate systems, at least 16 full-scale anaerobic treatment facilities are currently in operation worldwide, and another 9 are either in start-up or are under construction. The characteristics of many of the process effluents from pulp and paper mill operations are well suited for degradation by anaerobic processes. These waste streams are warm and contain low molecular weight organic acids, alcohols, and sugars that are readily metabolized to methane by anaerobic bacteria. Inorganic sulfur, wood extractives, and certain organic and inorganic additives can produce inhibitory or toxic conditions that must be dealt with in the design and operation of an anaerobic treatment facility. Several anaerobic process configurations have been successfully applied to treatment of pulp and paper mill wastewaters, including: anaerobic lagoon, anaerobic contact, upflow anaerobic sludge blanket, anaerobic filter, anaerobic fluidized bed, and hybrids of two or more of these basic configurations. No single process is best for all applications. Each configuration has unique advantages as well as tradeoffs, compared with other anaerobic processes. Treatment objectives, waste characteristics, and site-specific factors will influence which systems are technically and economically the most attractive for each application. (Author's abstract)
W89-12296

BIODENITRIFICATION OF URANIUM REFINERY WASTEWATERS.
Oak Ridge National Lab., TN. Chemical Technology Div.
J. F. Walker, M. V. Helfrich, and T. L. Donaldson.
Environmental Progress, Vol. 8, No. 2, p 97-101, May 1989. 8 fig, 1 tab, 7 ref. U.S. Department of Energy contract DE-AC05-84OR21400.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Industrial wastes, *Industrial wastewater, *Nitrates, *Denitrification, *Fluidized bed process, Uranium refinery, Oak Ridge National Laboratory, Pretreatment of Wastewater.

Design verification studies and process development work were conducted at Oak Ridge National Laboratory in support of the new fluidized-bed biodenitrification system under construction at the Feed Materials Production Center (FMPC) in Fernald, Ohio. Two bioreactors in series, each 6-m tall, and one 12-m-tall bioreactor were operated for approximately 9 months using synthetic and actual wastewaters from the FMPC. The results indicate that satisfactory reaction rates can be achieved and maintained; however, some degree of water softening, pH adjustment within the bioreactors, and temperature control may be necessary. (Author's abstract)
W89-12297

TREATMENT OF HAZARDOUS SUBSTANCES IN WASTEWATER TREATMENT PLANTS.
California Univ., Los Angeles.
M. K. Stenstrom, L. Cardinal, and J. Libra.
Environmental Progress, Vol. 8, No. 2, p 107-112, May 1989. 7 fig, 3 tab, 13 ref. Center for the Engineering and Systems Analysis for the Control of Toxics (ESACT) Grant No. 4-482591-19909.

Descriptors: *Hazardous materials, *Wastewater treatment, *Biological wastewater treatment, *Municipal wastewater, *Industrial wastewater, Hydrocarbons, Xylenol, Cresol, Isophorine, Biodegradation, Activated sludge, Urban runoff, Enzymes, Metabolism, Alicyclic hydrocarbons.

For many types of hazardous wastes, particularly those contained in high volume, low concentration wastewaters, biological treatment in existing facilities, perhaps in selected publicly owned treatment works, may be the better alternative. The motivation for using existing biological facilities to treat hazardous wastes is very high since it is a way to increase scarce hazardous waste treatment capacity. To evaluate the suitability of conventional plants to treat wastes that can be biodegraded or adsorbed to sludge, and those that cannot be conveniently isolated from municipal waste or urban runoff, a survey of industrially significant candidate compounds was made and several were selected for experimental investigation. A 2-year investigation was conducted using 12 liter complete mixing biological reactors, with integral clarifiers. The test compounds included isophorine, several isomers of xylenol, and the three isomers of cresol. The results indicate that many of the biodegradation reactions are mediated by enzymes of broad specificity, inducible by structurally related compounds. Exposure of the bacteria to a single compound can induce the production of enzymes that can partially or completely metabolize a whole class of compounds. In activated sludge there is a potential for the induction of many degradation pathways. Enriching activated sludge in microorganisms that utilize a particular pathway can enhance the degradation of other aromatic or alicyclic hydrocarbons that may also be degraded by that pathway. (Sand-PTT)
W89-12298

WASTE TREATABILITY TESTS OF SPENT SOLVENT AND OTHER ORGANIC WASTEWATERS.
Environmental Protection Agency, Cincinnati, OH. Risk Reduction Engineering Lab.
R. J. Turner.
Environmental Progress, Vol. 8, No. 2, p 113-119, May 1989. 5 fig, 6 tab, 2 ref.

Descriptors: *Solvents, *Wastewater treatment, *Biological wastewater treatment, *Industrial wastewater, *Steam stripping, *Activated carbon, Activated sludge, Organic compounds, Comparison studies.

Some commercial and industrial facilities treat RCRA Resource Conservation and Recovery Act spent solvent wastewaters by steam stripping, carbon adsorption and/or biological processes. Thirteen facilities were visited by EPA's Office of Research and Development from June 1985 to September 1986, to conduct sampling and analysis episodes and to determine the levels of performance achievable by these and other treatment processes. This paper summarizes the results of five of the tests: two steam strippers, two carbon adsorption systems, and one activated sludge biological system. In general, all three treatment techniques effectively removed specific volatile organic compounds to low residual concentrations. (Author's abstract)
W89-12299

IMPROVED CLARIFIER PERFORMANCE AND CAPACITY THROUGH THE USE OF A FLOW CONTRACTION BAFFLE.
Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
P. L. Silveston, and R. R. Hudgins.
Environmental Progress, Vol. 8, No. 2, p 130-138, May 1989. 13 fig, 2 tab, 14 ref.

Descriptors: *Wastewater facilities, *Wastewater treatment, *Biological wastewater treatment, *Clarifiers, *Baffles, Activated sludge process, Performance evaluation, Pilot Plants, Primary wastewater treatment.

Tests were conducted over several years on the effectiveness of a flow contraction baffle installed in a pilot-scale clarifier to separate solids from both primary sewage and activated sludge mixed liquor. Tests used two matched, 1.2-m diameter clarifiers, one of which was fitted with the baffle, in the form of a truncated cone descending from the effluent weir. Effectiveness of the flow contraction baffle results from the suppression of additive interference of density waves always present in clarifiers as well as provision for the uniform withdrawal of the clarified liquor. (Author's abstract)
W89-12301

CHARACTERIZATION OF CHLOROPHENOL AND CHLOROMETHOXYBENZENE BIODEGRADATION DURING ANAEROBIC TREATMENT.
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
S. L. Woods, J. F. Ferguson, and M. M. Benjamin.
Environmental Science and Technology ESTHAG, Vol. 23, No. 1, p 62-68, January 1989. 7 fig, 3 tab, 10 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Biodegradation, *Phenols, *Chlorinated hydrocarbons, *Benzenes, Biological treatment, Digestion, Tracers, Lithium, Mineralization, Organic compounds, Industrial wastes, Chemical reduction, Chemical reactions, Acclimatization, Molecular structure.

Chlorophenols, Chloroguaiacols, chloroveratroles, and chlorocatechols were continuously treated in an upflow anaerobic sludge blanket reactor in the presence of high concentrations of readily biodegradable organic compounds. The chlorinated compounds were not completely mineralized, but were converted to lesser chlorinated compounds by biologically mediated reductive dechlorination reactions. Chlorinated veratroles were converted to chloroguaiacols and then to chlorocatechols before they were reductively dechlorinated. Reductive dechlorination reactions are dependent on chlorine position, with preference for the removal of chlorines from positions adjacent to hydroxyl groups. With acclimation, meta chlorines are also removed. There was no evidence for the removal of para chlorines during this study. There was also no evidence for dechlorination of monochlorophenols. The ability of anaerobic consortia to reductively dechlorinate highly chlorinated compounds makes anaerobic processes attractive as a treatment alternative. Once dechlorinated, lesser chlorinated phenols may be readily degraded in aerobic treatment processes. (Author's abstract)
W89-12382

COMPLEX OPERATION OF TARP MAINSTREAM SYSTEM SIMPLIFIED BY COMPUTER CONTROLS.
Metropolitan Sanitary District of Greater Chicago, IL.
F. E. Dalton, and B. B. Goyal.
Public Works PUWOAH, Vol. 120, No. 5, p 73-76, May 1989. 4 fig, 3 tab.

Descriptors: *Tunnels, *Reservoirs, *Wastewater facilities, *Chicago, *Remote control, *Water pollution control, *Flood control, Planning, Computers, Pumping plants, Pumps, Water conveyance, Water distribution, Reservoir storage, Combined sewer overflows, Illinois, Automation.

Remote operation is a key factor in the design of the Metropolitan Sanitary District of Greater Chicago's Mainstream Pumping Station for the Tunnel and Reservoir Plan (TARP). TARP, or the 'Deep Tunnel Project,' is the world's largest pollution and flood control project. It is a system of deep tunnels as well as reservoirs, pumping stations, and sewage treatment plants for collecting, storing, and treating mixed wet weather and sanitary flow (combined sewage) from a 375-square-mile Chicago metropolitan area. The master station located at

the process control center consists of two active redundant Modcomp Classic 7861 computers. During the month of August 1987, when record rainfalls were experienced, peak capture, pumping, and subsequent treatment of combined sewer overflows were carried out. This level of treatment has been possible because reliable power and state-of-the-art computer controls have been provided for the safe operation of the Mainstream System. The system controls have also been designed to operate the Mainstream System efficiently when the flood control reservoir phase is implemented. (Author's abstract)
W89-12397

CHARACTERIZATION OF CARBOXYLESTERASE FROM MALATHION DEGRADING BACTERIUM: PSEUDOMONAS SP. M-3.
Industrial Toxicology Research Centre, Lucknow (India). Developmental Toxicology Div.
A. K. Singh, N. S. Srikanth, O. P. Malhotra, and P. K. Seth.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 6, p 860-867, June 1989. 4 fig, 1 tab, 9 ref.

Descriptors: *Biochemical tests, *Microbial degradation, *Wastewater treatment, *Enzymes, *Malathion, *Pseudomonas, *Bacterial physiology, *Detoxification, Metabolism, Kinetics, Hydrogen ion concentration, Temperature, Bacteria, Industrial wastewater, Hydrolysis.

In order to explore the possibility of degrading high amounts of malathion in wastewater, an attempt was made to study the characteristics of the enzymes found capable of degrading malathion in aquatic medium. Crude enzyme extracts obtained from Pseudomonas sp. M-3, isolated from a paper-mill effluent and capable of degrading malathion, showed a specific activity of 900 nmoles malathion hydrolyzed/min/mg protein. The lower Km (2.5 microM) and higher Vmax (1240 nmoles malathion hydrolyzed/min/mg protein) value of the carboxylesterase of Pseudomonas sp. M-3 in comparison to some other bacteria suggest that the enzyme has higher affinity for malathion than that observed with the other bacterial enzymes. The enzyme was active between 20 and 45 C, with optimal activity occurring at 30 C. The enzyme extract was active over a wide pH range (6-9), and the optimal enzyme activity occurred at pH 7.5. Lack of any significant effect of high salts and solvent concentrations on the enzyme activity and the ability of the enzyme to actively carry out the hydrolysis of the pesticide over a broad range of temperature and pH, suggests a great potential for its use to treat industrial effluents. However, further studies are needed to confirm this. (Doria-PTT)
W89-12448

EVALUATION OF SURFACE AND FILM DIFFUSION COEFFICIENTS FOR CARBON ADSORPTION.
Illinois Univ., Urbana. Dept. of Civil Engineering.
U. K. Traegner, and M. T. Suidan.
Water Research WATRAG, Vol. 23, No. 3, p 267-273, March 1989. 9 fig, 13 ref. U.S. DOE Grant No. DE-FG22-86PC9051 and U.S. EPA Cooperative Agreement CR812582-02.

Descriptors: *Wastewater treatment, *Model studies, *Water treatment, *Adsorption, *Activated carbon, *Diffusion coefficient, *Filter media, Carbon filters, Adsorbents, Design criteria.

The dynamics of adsorption for various adsorbate-adsorbent systems have been predicted successfully using the homogeneous surface diffusion model (HSDM). This model can be used as a tool for the design engineer who is interested in planning the scope of pilot scale studies, interpreting pilot scale test results, or estimating preliminary costs for granular activated carbon adsorber units. Kinetic parameters and equilibrium parameters have to be determined in order to solve the model. Batch adsorption experiments are usually used for this purpose. A parameter search procedure is presented which is capable of uniquely determining these parameters for the HSDM. The advantage of the proposed parameter search procedure is that it is not limited to cases of dominant transport mechanism, such as cases limited by either external film or surface diffusional resistances. (Author's abstract)
W89-12478

HEAVY METAL SOLIDS ASSOCIATION IN SEWAGE SLUDGES.
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
D. L. Lake, P. W. W. Kirk, and J. N. Lester.
Water Research WATRAG, Vol. 23, No. 3, p 285-291, March 1989. 3 fig, 6 tab, 33 ref.

Descriptors: *Sludge solids, *Wastewater treatment, *Sludge digestion, *Metal complexes, *Wastewater treatment, *Heavy metals, Ion-selective electrodes, Filtration, Activated sludge, Digested sludge, Cadmium, Copper, Lead.

In order to study the metal binding characteristics of raw, activated, and anaerobically-digested sewage sludges, each sludge was passed through a range of filter pore sizes. Each filtrate was then subjected to complexation titration with cadmium, copper, and lead using ion-selective electrodes to follow the free metal ion concentration. Calibration of the electrodes was extended using metal-ion buffer standards. Conditional stability constants and complexation capacities were determined for each metal in each sludge fraction. The stability of complexes formed in each sludge type followed the general order copper>lead>cadmium. Both copper and lead formed more stable complexes in the treated sludges than in the raw sludge. In general, the capacities of raw and digested sludges to complex all three metals (in terms of unit mass of solids) decreased with increasing particle size. However, the converse was true for activated sludge, particularly for copper, suggesting a lesser contribution from surface area related phenomena. It is concluded that the digestion of sludge plays an important role in controlling the mobility and environmental dispersion of these metals. (Author's abstract)
W89-12480

EVALUATION OF THE EFFICIENCY OF ULTRAVIOLET DISINFECTION SYSTEMS.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
R. G. Qualls, M. H. Dorfman, and J. D. Johnson.
Water Research WATRAG, Vol. 23, No. 3, p 317-325, March 1989. 8 fig, 1 tab, 22 ref. National Science Foundation Grant No. CEE-8205274.

Descriptors: *Wastewater treatment, *Ultraviolet radiation, *Quantative analysis, *Disinfection, *Bioassay, Bacteria, Bacillus, Survival, Light intensity, Fluid mechanics, Absorption, Performance evaluation, Comparison studies.

One problem in using ultraviolet light (u.v.) for full scale wastewater disinfection is the difficulty in measuring the dose of u.v. and in monitoring the immediate results of disinfection. A bioassay method for measuring the average u.v. intensity and the residence time distribution (RTD) was tested on two small and two large multiple-lamp u.v. systems. Spore suspensions of u.v. resistant Bacillus subtilus were injected into the u.v. units as a spike and collected at a known time from injection in the effluent so that the exposure time was known. The survival could be related to a standard curve of survival versus u.v. dose. In one unit the bioassay measurements of intensity corresponded well with the predictions of a method of calculating intensity across a wide range of fluid u.v. absorbance values. The problems with interpreting the results of a continuous flow of the bioassay spores were demonstrated. The measurement of average intensity, RTD, volume of the chamber and the lamp u.v. output enabled us to assign measures of capacity and efficiency to the systems. The analysis illustrated a means of quantitatively isolating the factors involved in the overall efficiency of the disinfection system and a means of comparing different systems. (Author's abstract)
W89-12484

ANALYSIS OF DISINFECTION DATA FROM DILUTION COUNT EXPERIMENTS.
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5F.
W89-12488

EVALUATION OF SETTLEABILITY OF ACTIVATED SLUDGE USING A SLUDGE SETTLING ANALYZER.
Meidensha Corp., Tokyo (Japan). Development Div.
T. Sekine, H. Tsugura, S. Urushibara, N. Furuya, and E. Fujimoto.
Water Research WATRAG, Vol. 23, No. 3, p 361-367, March 1989. 13 fig, 1 tab, 12 ref.

Descriptors: *Sludge solids, *Measuring instruments, *Settleable solids, *Wastewater treatment, *Activated sludge, *Sludge volume index, Settling velocity, Data interpretation, Automation, Preformance evaluation.

An effective system has been developed to estimate sludge settleability, which consists of a sludge volume index (SVI) measuring block and a data analyzing block. A settling test using this system was conducted to determine settling characteristics in a full-scale activated sludge process. As a result relationships have been discovered between various parameters concerned with sludge settling curves, such as the initial settling velocity (ISV), compression point, the Roberts constant and the SVI, generally used as sludge settleability. (Author's abstract)
W89-12490

CONTROL OF SEWAGE FILTER FLIES USING BACILLUS THURINGIENSIS VAR. ISRAELENSIS--I. ACUTE TOXICITY TESTS AND PILOT SCALE TRIAL.
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Mechanical and Mfg. Systems Engineering.
J. Houston, B. N. Dancer, and M. A. Learner.
Water Research WATRAG, Vol. 23, No. 3, p 369-378, March 1989. 9 tab, 48 ref.

Descriptors: *Wastewater treatment, *Toxicity, *Filtration, *Bacillus, *Insect control, Biological filters, Microbiological studies, Pilot plants, Biocontrol, Performance evaluation.

The possible use of the entomopathogenic bacterium, Bacillus thuringiensis var. israelensis (Bti) to control fly nuisance associated with sewage filter beds was investigated. Acute toxicity tests using Teknar, a commercial formulation of Bti, showed it to be toxic to the nuisance species Limnophyes minimus, Metriocnemus hygropetricus, Psychoda severini, and Sylvicola fenestralis. Twenty-four-hour LC90 (lethal concentration for 90% of the test population) values for these species ranged from 110,000 to 55,000,000 spores per square centimeter. The application of Bti (Teknar) to pilot scale filter beds to give a theoretical concentration of 1,400,000,000 spores per square centimeter of medium in the top 15 centimeters of each treated bed successfully killed almost all M. hygropetricus and P. severini larvae present without seriously reducing the efficiency of sewage treatment. The non-target organisms were unaffected. (See also W89-12492) (Author's abstract)
W89-12491

CONTROL OF SEWAGE FILTER FLIES USING BACILLUS THURINGIENSIS VAR. ISRAELENSIS--II. FULL SCALE TRIALS.
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Mechanical and Mfg. Systems Engineering.
J. Houston, B. N. Dancer, and M. A. Learner.
Water Research WATRAG, Vol. 23, No. 3, p 379-385, March 1989. 3 fig, 2 tab, 15 ref.

Descriptors: *Filtration, *Wastewater treatment, *Bacillus, *Insect control, *Microbiological studies, Biological filters, Effluents, Wales, Biocontrol, Performance evaluation.

The effectiveness and suitability of the entomopathogenic bacterium, Bacillus thuringiensis var. israelensis (Bti), for controlling nuisance flies associated with sewage filter beds was investigated at Cowbridge Sewage Works, South Wales. Teknar, a commercial formulation of Bti containing 1,160,000,000,000 spores per cubic centimeter, was applied to an operational filter bed in 1985 and 1986. The trials showed that two applications of Teknar, three weeks apart, each of 40 liters delivered in 2,650 liters of settled sewage reduced the numbers of emerging Metriocnemus hygropetricus, Orthocladius fuscimanus, Psychoda alternata and P. severini by >70% over eight weeks; this dose was less effective against Limnophyes minimus. Operation of the works, non-target filter bed organisms, purification efficiency, and the benthic fauna of the stream to which the works' effluent discharged, were unaffected by Bti treatment. The results indicate that Bti is suitable for use on sewage filter beds to control nuisance flies. (See also W89-12491) (Author's abstract)
W89-12492

SELECTION OF AN ANTIBIOTIC-RESISTANT STRAIN OF BACILLUS SUBTILIS VAR. NIGER (B. GLOBIGII) FOR USE AS A TRACER IN MICROBIALLY RICH WATERS.
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Mechanical and Mfg. Systems Engineering.
J. Houston, M. A. Learner, and B. N. Dancer.
Water Research WATRAG, Vol. 23, No. 3, p 387-388, March 1989. 2 tab, 5 ref.

Descriptors: *Environmental tracers, *Wastewater treatment, *Culturing techniques, *Bacillus, *Antibiotics, Microbiological studies, Microorganisms, Filters, Effluents, Glucose, Agars.

As part of a study of the use of Bacillus thuringiensis var. israelensis (Bti) for the control of nuisance flies in sewage filter beds, it was necessary, in preliminary experiments, to use a non-entomopathogenic bacterium to indicate (a) the extent to which Bti would be retained within filter beds, and (b) the Bti concentrations likely to be present in the sewage-works effluent. An obvious candidate for the role was Bacillus subtilis var. niger. Spores of this Bacillus have been used frequently in the water industry, mostly to indicate the likely pattern of dispersion from projected sewage outfalls into marine and fresh waters. Five antibiotics were tested for their ability to inhibit growth of microorganisms present in sewage filter effluent which had been heat treated at 80 degrees Centigrade for 10 minutes. Rifampicin (5 micrograms per milliliter) added to tryptone-glucose-agar (TGA) medium completely suppressed microbial growth. Subsequently, a mutant of Bacillus subtilis var. niger NCIB 8649 was isolated which was resistant to rifampicin. Spores of this mutant were mixed with sewage filter effluent and samples of the mixture were heat treated and plated on rifampicin-supplemented TGA medium. The resulting Bacillus colonies were easily detected and counted because there was no interference from other microbes. This antibiotic-resistant strain, therefore, offers a significant improvement over the wild-type strain as a tracer in microbially-rich waters. (Author's abstract)
W89-12493

WASTEWATER COLLECTION.
Geo-Marine, Inc., Plano, TX.
J. H. Forbes.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 786-789, June 1989. 66 ref.

Descriptors: *Literature review, *Wastewater collection, *Municipal wastewater, Monitoring, Infiltration, Aquifers, Septic tanks, Rehabilitation, Planning, Design, Construction, Hazardous wastes, Maintenance, Financing.

Review of the planning, design, and construction of wastewater collection systems includes: an eight point program for renewing national research in wastewater technology to reduce the municipal investment by the year 2005; plans to finance infrastructures in major cities; strategies for controlling combined sewer overflows and the impact on receiving streams; a rotating-drum reactor to assess sulfide generation in sewers where industrial wastes were present; aquifer protection from septic tanks; and methods for the design and placement of sewer lines. Sewer system evaluations using models, spreadsheet calculations, flow monitoring for assessing infiltration problems, and the Ridge Regression are presented. Rehabilitation approaches and safety programs concerned with the risk potential of wastewater viruses, including the AIDS virus, and disinfection methods are characterized. Various maintenance/pumping methods are reviewed along with types of pipe and joint materials used in collection systems. Current information concerning hazardous wastes disposal is reviewed. (White-Reimer-PTT)
W89-12506

WASTEWATER TREATMENT--PHYSICAL AND CHEMICAL METHODS.
Maryland Univ., College Park.
R. W. Walters, A. L. Tarleton, D. Grasso, I. Al-Ghusain, and Y. Chin.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 789-799, June 1989. 193 ref.

Descriptors: *Literature review, *Wastewater treatment, *Physicochemical treatment, Neutralization, Stabilization, Precipitation, Coagulation, Flocculation, Sedimentation, Filtration, Flotation, Adsorption, Ozonation, Ion exchange, Mass transfer, Air stripping, Oxidation/reduction, Photolytic processes, Membrane processes, Heavy metals, Toxicity.

Methods for treating olive-mill, metal-bearing and solvent, oil and grease, urban landfill, and spent caustic wastes are reviewed along with the fate of heavy metals during conventional treatment, toxicity reduction in effluents, and costs and techniques for dealing with hazardous wastes. Wastewater treatment processes discussed include: neutralization, stabilization, precipitation, coagulation/flocculation, sedimentation, filtration, flotation, adsorption, ozonation, ion exchange, water/gas mass transfer, air stripping, oxidation/reduction, photolytic processes, membrane processes, and innovative processes such as synthetic polymer membranes and gas membrane-ion exchange. (White-Reimer-PTT)
W89-12507

ACTIVATED SLUDGE.
CH2M Hill, Inc., Gainesville, FL.
R. O. Mines, J. Silverstein, J. H. Sherrard, M. S. Kennedy, and A. S. Weber.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 799-807, June 1989. 146 ref.

Descriptors: *Literature review, *Activated sludge process, *Wastewater treatment, Oxygen transfer, Industrial wastes, Nitrogen, Phosphorus, Sludge, Solids, Toxic substances, Bioaugmentation.

A review of current research on the activated sludge process includes process models that simulate steady state and time-dependent performance of completely mixed reactors in series, the behavior of bacteria in sludge, plant design, the behavior of toxic organic wastes, and control strategies. Process research subjects such as bioaugmentation, batch and fed-batch studies of pure bacterial cultures, the use of entrapped microbial cells for soluble organic wastewater treatment, and protozoan grazing on flocculated activated sludge are discussed. Other aspects of the activated sludge process reviewed are: design, control, performance, and operation; oxygen transfer; xenobiotic compound removal; industrial wastes; nitrogen and phosphorus; sludge characteristics; and solids separation. (White-Reimer-PTT)
W89-12508

BIOLOGICAL FIXED-FILM SYSTEMS.
New Hampshire Univ., Durham. Dept. of Civil Engineering.
N. E. Kinner, and T. T. Eighmy.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 807-810, June 1989. 58 ref.

Descriptors: *Water treatment, *Literature review, *Biological treatment, *Biofilms, *Wastewater treatment, *Biofilters, Filter media, Trickling filters, Activated carbon, Model studies, Submerged beds, Fluidized beds, Biofilms.

A review of package treatment systems includes information on biofilm processes, conference proceedings, and fixed-film processes in water, wastewater, and hazardous waste treatment. Mass transfer and axial dispersion coefficients were generated from a forward-mixing model using experimental data from two rotating biological contactors. Successful innovations in trickling filter design, including use of plastic media and the solids contact process, were cited as examples of direct benefits of conducting research in wastewater treatment technology. Two pilot-scale submerged filters, operated in an aerated up-flow mode, were used to treat a refinery waste under normal and shock load conditions. Fluidized beds were modelled according to the mixture theory. Residence time distribution analysis was used to design packed bed configurations allowing accurate kinetic modelling and desired flow patterns. A dual media filter, granular activated carbon and sand, outperformed a sandfilter used in municipal water treatment. Results of 2 years of operation of a full scale biological aerated filter indicated that media size was an important design parameter. In addition, a review of biofilms in piping systems, growth, natural characteristics, and model studies are presented. (White-Reimer-PTT)
W89-12509

LAGOONS AND POND.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
J. P. A. Hettiaratchi, and D. W. Smith.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 810-814, June 1989. 92 ref.

Descriptors: *Wastewater treatment, *Literature review, *Stabilization lagoons, *Stabilization ponds, Performance, Model studies, Brazil, France, Venezuela, Portugal, Jordan, South Africa, Design, Aerated lagoons, Facultative ponds, Nitrogen, Phosphorus.

IAWPRC proceedings from the conference held in Lisbon, Portugal on waste stabilization systems are reviewed. Other articles reviewed discuss the concepts, performance and contaminant removal mechanisms in macrophyte based wastewater treatment systems. The importance of mixing, organic content, and difficulty of simulating nitrogen feedback was addressed in papers concerning system design and modelling. Biological considerations included pH, temperature, dissolved oxygen, algae, coliforms, pesticide contamination, protozoa, and fish culture. Performance studies were described from Brazil, France, Venezuela, Portugal, Jordan, and South Africa. The performance of both aerated lagoons and/or facultative ponds were evaluated with regard to microbial removal, swine and dairy wastes, sea-based solid wastes, ammonium removal, and phosphorus removal. Performance improvement through the use of macrophytes and/or chemical treatment was also discussed. (White-Reimer-PTT)
W89-12510

ANAEROBIC PROCESSES.
Massachusetts Univ., Amherst. Dept. of Microbiology.
R. F. Hickey, and S. Goodwin.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 814-821, June 1989. 135 ref.

Descriptors: *Biological wastewater treatment, *Literature review, *Wastewater treatment, *Microbial degradation, *Anaerobic digestion, *Sludge

digestion, Anaerobic bacteria, Temperature, Methane, Phenol, Design, Monitoring.

Microbiological aspects of wastewater treatment reviewed include: isolation of H2/CO2; optimum growth temperatures; methanogenic populations; sodium inhibition; antigenic fingerprinting to quantify the diversity of microbial populations in digesters; methanogenic activity; energetics and kinetics of hydrogen metabolism in syntrophic, methanogenic cocultures; rumen derived microorganisms; and phenol degradation inhibition by cresols and ethylphenols. Other topics reviewed are: process monitoring, control, and modeling utilizing ATP, degradation rates and adaptive control algorithms; attachment, granulation, and start-up of anaerobic systems involving inoculum quality; acidogenic conversions; high-rate anaerobic reactor operation comparing the performances of packed bed and fluidized bed, activated and unactivated carbon, anaerobic filters, and two-stage digestion using an anion exchange system; and anaerobic digestion of sludge municipal solid waste using iron salts for control of H2S in anaerobic digesters, batch bioassays, and other recent advances. (White-Reimer-PTT)
W89-12511

SLUDGE TREATMENT, UTILIZATION, AND DISPOSAL.
Metcalf and Eddy, Inc., Wakefield, MA.
P. T. Bowen, J. E. Hendrick, T. A. Woodward, L. S. Mitchell, and M. Lahlou.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 821-829, June 1989. 191 ref.

Descriptors: *Wastewater treatment, *Literature review, *Sludge utilization, *Sludge disposal, *Sludge digestion, *Sludge conditioning, *Sludge thickening, *Sludge drying, Pathogens, Case histories, Thermal processes.

Sludge generation, characteristics, and treatment along with handling costs, future projections, and possible uses are reviewed. Recent work on sludge properties, thickening and clarification, conditioning, dewatering, and thermal processes are discussed. Work on sludge stabilization and inactivation included general processes involving particle size reduction, enzyme hydrolysis, alkali hydrolysis and solids removal; and specific work on composting, pathogen reduction, aerobic digestion, and case histories for a number of cities. Studies on disposal include land application, composting, and ocean disposal. The relationship between sludge characteristics and viruses, detection methods, viral inactivation and fate during treatment were examined along with the general problem of pathogenic contamination and isolation techniques. Case histories for a number of sludge disposal systems are presented. Studies on the treatment and disposal of sludges from pulp and paper mills and water treatment plants is also reviewed. (White-Reimer-PTT)
W89-12512

ON-SITE ALTERNATIVES FOR TREATMENT AND DISPOSAL.
ENSR Contructors, Acton, MA.
S. M. Pause.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 830-834, June 1989. 76 ref.

Descriptors: *Wastewater treatment, *Waste disposal, *Literature review, *On-site wastewater treatment systems, *Septic tanks, Planning, Design, Model studies, Case studies, Installation, Costs, Operation, Percolation.

Current research on on-site alternatives for treatment and disposal of wastes are reviewed. Topics reviewed include planning and siting of individual systems in which several papers were concerned with state or local planning and management programs; design of individual systems discussing the relationship between soil and site conditions and septic tank design, gravel-less leach bed technology, and the design, installation, operation, and costs of a low-pressure pipe sewage absorption system; performance of individual systems using color infrared aerial photography, long-term performance of a pressure-dosed septic tank filter, absorption units, and ultraviolet disinfection; attenuation of pollutants by means of downward percolation through chalk, modelling studies, curtain drains, soil columns, and nitrogen removal; community systems involving low-cost wastewater treatment concepts for small to medium-sized communities and the use of artificial wetlands and aquatic plants; and septage management studies. (White-Reimer-PTT)
W89-12513

DISINFECTION.
University of South Florida, Tampa. Coll. of Public Health.
C. I. Noss, and R. Isaac.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 834-839, June 1989. 92 ref.

Descriptors: *Disinfection, *Literature review, *Wastewater treatment, *Chlorination, Irradiation, Ultraviolet radiation, Resins, Cobalt irradiation, Treatment systems, Ozone, Activated carbon.

Recent studies on wastewater disinfection is reviewed. In the area of microbiology a variety of studies using halogens have been conducted using monochloramines, hypochlorous acid, chlorine, and N-halomine compounds for disinfection. Other studies used oxychlorine, ozone, ultraviolet radiation, resin contact, magnesium peroxide, ferrate and ozone, mercury lamp irradiation, cobalt irradiation, and hyperchlorination for hospital cooling towers. Chemical studies looked at the interferences caused by organic chloramines and monochloramine in measuring free chlorine; techniques to measure by-products of chlorination; the formation and control of byproducts; physical-chemical reactions involving phosphate and sulfate, bromine, and ozone with substances such as NH3, styrene, and CN(-). Treatment systems using ozone/granular activated carbon; ozone, UV-ozone and then UV in series, and granular activated carbon are discussed. (White-Reimer-PTT)
W89-12514

TREATMENT PLANT MANAGEMENT, OPERATION, AND MAINTENANCE.
Baker/TSA, Inc., Coraopolis, PA.
G. M. Wong-Chong.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 839-840, June 1989. 33 ref.

Descriptors: *Literature review, *Wastewater facilities, Management, Safety, Instrumentation, Economic aspects.

Alternative and innovative means of financing the up-grading, operation and maintenance of treatment facilities are reviewed. Methods reviewed include privatization, leasing and contract operation. Safety is also a major concern and the development and effectiveness of a variety of safety programs such as safety training, use of hazardous materials, emergency response plans, and on-site operator training are reviewed. Due to the demand for compliance with effluent limits and the constraints of tight economics, the wastewater treatment industry has turned to process instrumentation, automation, and computerization of their facilities. Recent innovations in this area such as activated sludge monitors, bio-nutrient removal plants, and centralized management are discussed. (White-Reimer-PTT)
W89-12515

WATER RECLAMATION AND REUSE.
California State Water Resources Control Board, Sacramento.
For primary bibliographic entry see Field 3C.
W89-12516

LAND APPLICATION OF WASTEWATER.
Dames and Moore, Atlanta, GA.
J. Zirschky, and A. R. Abernathy.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 844-845, June 1989. 27 ref.

Descriptors: *Wastewater treatment, *Wastewater irrigation, *Literature review, *Land disposal, *Wastewater disposal, Irrigation, Nutrient removal, Pathogens, Groundwater, Wetlands.

Recent studies on land application of wastewater are reviewed. The economics and energy requirements of a trickling filter system and a forested slow rate system were compared, and the use of wastewater in lieu of groundwater for agricultural irrigation; treatment costs; raw wastewater irrigation; and salinity, sodicity, nitrate, and pathogen concentration aspects are discussed. A case study of the use of electronic controls for a rapid infiltration system is presented along with phosphorus removal associated with CaCO3 in these systems. The use of natural and artificial wetlands for removing organics, nitrogen, phosphorus, and solids is reviewed. (White-Reimer-PTT)
W89-12517

HEALTH EFFECTS ASSOCIATED WITH WASTEWATER TREATMENT, DISPOSAL, AND REUSE.
Alberta Univ., Edmonton. Div. of Health Services Administration.
For primary bibliographic entry see Field 5C.
W89-12519

MEAT, FISH, AND POULTRY PROCESSING WASTES.
Battelle Memorial Inst., Columbus, OH.
W. T. McComis, and J. H. Litchfield.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 855-858, June 1989. 44 ref.

Descriptors: *Food-processing wastes, *Literature review, *Meat processing industry, *Poultry, *Food processing industry, *Wastewater treatment, Biological wastewater treatment, Activated sludge process, Flocculation, Aerobic digestion, Anaerobic digestion, Case studies, Flotation, Filtration, Ozonation.

Reviews for meat processing wastewater treatment and by-products recovery include biological treatment methods, applications of biotechnology, and recovery of proteins and fats. Treatment processes included activated sludge, pasture irrigation with effluent, an anaerobic contact process, dewatering, fat separation, electroflotation, and ultra filtration membranes. Wastes from fish processing plants were monitored and treated by a variety of methods including activated sludge, marsh polishing, sedimentation, chemical coagulation/flocculation, aerobic biological processes, oxic-anoxic-oxic activated sludge, alum, polyamide membranes, and HOAc to remove protein prior to anaerobic digestion. Poultry processing systems reviewed included dissolved air flotation, aerobic and anaerobic lagoons, ozonation, screening and diatomaceous earth filtration, shell-and-tube microfiltration, anaerobic packed bed reactors, and anaerobic filtration followed by a sequencing batch reactor activated sludge process. In addition, case studies dealing with removal efficiencies are discussed. (White-Reimer-PTT)
W89-12520

FRUIT, GRAIN, AND VEGETABLE WASTES.
Brigham Young Univ., Provo, UT. Dept. of Civil Engineering.
M. B. Borup, and G. W. Potter.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 858-860, June 1989. 45 ref.

Descriptors: *Literature review, *Food processing industry, *Wastewater treatment, *Food-processing wastes, *Biological wastewater treatment, Anaerobic digestion, Trickling filters, Aeration, Activated sludge, Reverse osmosis, Ultrafiltration, Rotating biological contactors, Fruit, Grain, Vegetables.

Studies on the waste treatment of fruit, grain, and vegetable wastes are reviewed including discussions on design, operation, optimization and regulatory issues. For the fruit industry case studies using apple pumice and olive black water are discussed in regard to treatment efficiencies. The magnitude and composition of wastes from corn processing plants and the use of trickling filters, extended aeration, activated sludge, reverse osmosis, ultrafiltration, and rotating biological contactors are discussed. In the area of vegetable processing recovery and reuse of vegetable fats and oils from waste materials of vegetable oil refining, degradation of onion wastes, pea and potato processing, and associated treatment processes are reviewed. Anaerobic digestion, process control and operating problems, and the use of thermophilic fungi to decolorize a molasses wastewater are discussed for sugar and molasses processing. (White-Reimer-PTT)
W89-12521

FERMENTATION INDUSTRY.
Alabama Univ. in Birmingham. School of Public Health.
J. F. Manning, and S. C. Chiesa.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 860-862, June 1989. 22 ref.

Descriptors: *Literature review, *Fermentation, *Wastewater treatment, *Industrial wastes, *Food-processing wastes, *Chemical wastes, *Alcohols, Resource recovery, Methane, Anerobic digestion, Soil injection, Activated sludge process, Coagulants, Chlorination, Aeration.

Current studies on distillery, brewery, pharmaceutical, and ethanol production wastes are reviewed. Methane production from distillery wastes was investigated utilizing fixed film anaerobic reactors. Thermophilic anaerobic processes, soil injection, and anaerobic filter systems were used for treating wastes and chemical oxygen demand removals are given for case studies. Removal efficiencies are given for a deep aeration yeast activated sludge process, anaerobic contact process, and an anaerobic fluidized bed system, as well as problems associated with using activated sludge for treating brewery wastes. The use of coagulants, an oxidation ditch activated sludge system, lime neutralization, clarification, activated sludge, post-aeration, and chlorination for treating pharmaceutical wastes are discussed. Resource recovery and methodology included using grape pomace to produce a wide range of food ingredients such as ethanol, tartrates, citric acid, food colorants, and grape seed oil; and the utilization of liquid by-products from several fermentation industries as supplements to traditional livestock feed. (White-Reimer-PTT)
W89-12522

DAIRY WASTES.
Brown (Floyd) Associates, Inc., Marion, OH.
K. A. Radick.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 862-863, June 1989. 18 ref.

Descriptors: *Literature review, *Wastewater treatment, *Food-processing wastes, Anaerobic digestion, Fuel production, Wastewater renovation, Activated sludge, Flotation, Case studies.

A review of dairy waste processing covers general studies, research and case histories. Comparisons of wasteloads discharged and the accounting records of five dairy facilities led to the development of cost-of-treatment data which was used for the development and implementation of a waste minimization program. Research studies included a report on the methodology and results of testing an anaerobic contact process, the viability of using high-moisture organic solid waste to generate medium Btu fuel gas, the effectiveness of bioaugmentation in treating dairy wastewaters, using secondary treated biological dairy wastes for sheep and swine feed, and nitrogen leaching to soil from whey applications. Case studies include final disposal of effluent from a facility receiving cheese processing wastes; in-plant waste reduction programs for a pretreatment facility consisting of grease removal, flow equalization, roughing filters and activated sludge; pretreatment using a high-rate dissolved air flotation process; and use of a sequencing batch reactor for two dairy facilities. (White-Reimer-PTT)
W89-12523

AGRICULTURAL WASTES.
C. C. Ross, S. R. Harper, and G. E. Valentine.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 863-872, June 1989. 152 ref.

Descriptors: *Wastewater treatment, *Literature review, *Farm wastes, *Fertilizers, *Manure, *Animal wastes, Waste recovery, Recycling, Anaerobic digestion, Aerobic treatment, Nutrients, Ammonia, Composting, Runoff, Odor control.

A review of recent studies on agricultural wastes includes information on: (1) Conferences; (2) Reviews of general wastes management practices, and anaerobic treatment research and demonstration projects; (3) Agricultural waste characteristics such as an updated ASAE Standard 'Manure Characteristics' which includes the addition of veal, goat, turkey, and duck; and a mathematical model predicting voided animal manure constituents based on animal mass and diet; (4) Fertilizer and soil supplements with emphasis on nutrient availability, ammonia volatilization, long-term impacts, and application methods; (5) Waste recycle and reuse for animal feedstuffs, aquaculture, chemical feedstocks, and energy conversion; (6) Agricultural waste treatment using anaerobic treatment for cattle, poultry, and swine wastes; aerobic treatment involving composting, vermicomposting, and digestion; and miscellaneous treatments using separation and mortality recovery and disposal; and Environmental impacts concerned with water quality and runoff control, and air quality and odor control. (White-Reimer-PTT)
W89-12524

TEXTILE WASTES.
ENSR Contructors, Acton, MA.
K. A. Groff, and B. R. Kim.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 872-876, June 1989. 124 ref.

Descriptors: *Literature review, *Textile mill wastes, *Textiles, *Wastewater treatment, *Biological treatment, *Physicochemical treatment, Dyes, Activated sludge, Anaerobic digestion, Sedimentation, Flocculation, Activated carbon, Filtration, Oxidation, Recycling.

A review of various treatment methods, environmental regulations, management issues, and environmental concerns with regard to textile manufacturing wastewaters and wastes are reviewed. Biological treatment methods include biodegradation of surfactants, complexing agents, and sizings; assessment of oxygen consumption by activated sludge in the treatment of dyeing effluents; removal of a red dye from wastewater using an activated sludge process; anaerobic treatment of cotton fabric desizing and scouring wastewater; and removal of triphenylmethane dyes using macrophytes with peroxidase activity. Physical and chemical treatments include coagulation with FeCl3, AlCl3, lime FeSO4, CaCO3, organic polymers, and Rhodoccus-based biocoagulant; flocculation; adsorption using activated carbon and carbon-mineral adsorbents; sedimentation; filtration; and contact oxidation. Changes in the manufacture of dyes, wastewater treatment, and conservation of water, energy, and chemicals during desizing, dyeing, printing, and finishing were considered for cutting costs and reducing wastes. (White-Reimer-PTT)
W89-12525

PULP AND PAPER EFFLUENT MANAGEMENT.
Western Michigan Univ., Kalamazoo.
F. S. Tirsch.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 876-879, June 1989. 50 ref.

Descriptors: *Literature review, *Wastewater treatment, *Pulp and paper industry, *Pulp wastes, *Biological treatment, *Physicochemical treatment, Anaerobic digestion, Aeration, Coagulation, Flotation, Adsorption, Sludge disposal, Toxicity, Environmental effects, Dioxins.

A review of pulp and paper effluent management includes: (1) Biological treatment processes using high speed direct drive aspirating propeller pump aerators with existing slow speed aerators; anaerobic treatment using the serum bottle technique; upflow anaerobic sludge beds; models for biochemical oxygen demand removal; and aerated lagoons; anaerobic digestion; (2) Physical-chemical treatment using a high speed fluid sludge bed clarifier; lime, bentonite, alum, and ferric sulfate for removal of soluble COD; organic polyelectrolytes in a coagulation and flotation separation treatment scheme; a patented continuous contactor incorporating stages of acidification, solid-liquid separation, and activated carbon adsorption; and wood pulp for metals removal; (3) Internal load control; (4) Sludge dewatering and disposal using dual polymer addition; and an evaluation of landfilling practices, and the impact of dioxin in land applied sludge; and a program to find a long term method for disposal of wastewater treatment sludge; (5) Effluent characterization and environmental effects of toxic constituents in effluents, receiving waters, and sediments; laboratory monitoring for toxicity, toxic effects in receiving waters, bioaccumulation and elimination of organics in mill effluents, and bioassay tests; stream monitoring with an equilibrium dissolved sensor; and the links between stream ecosystems and riparian land areas. (White-Reimer-PTT)
W89-12526

COAL AND COAL MINE DRAINAGE.
Olem Associates, Washington, DC.
For primary bibliographic entry see Field 5C.
W89-12527

PETROLEUM PROCESSING AND SYNTHETIC FUELS.
Stover and Bentley, Inc., Stillwater, OK.
J. A. Thomas, G. Ganapathi, and E. L. Stover.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 882-887, June 1989. 91 ref.

Descriptors: *Literature review, *Oil industry, *Petroleum products, *Oil wastes, *Synthetic fuels, *Wastewater treatment, Wastewater renovation, Nutrients, Activated sludge process, Anaerobic digestion, Groundwater pollution.

Studies on petroleum processing and synthetic fuels are reviewed. Topics covered in the field of petroleum processing include National Technical Information Service (NTIS) publications; recent developments in waste treatment covering the conversion of refuse and sludge into fuel oil, anaerobic fluidized beds, anaerobic rotating biological drum contactors, nitrate removal, and new methods for the treatment of liquid wastes; extraction of sour water containing phenols; use of the Haldane equation; high nutrient effects; COD removals; ozone treatment; sludge disposal by wet air oxidation; principles of oil-water separation; the effects of surface charges of oil droplets and bubbles in the oil-in-water flotation process; activated sludge; cooling water treatment; groundwater contamination problems; and refinery waste land treatment. Seepage and groundwater contamination from oil shales and oil sands are also discussed. In the area of synthetic fuels biotechnology in the coal industry, including its use for wastewater treatment; activated sludge treatability; sequencing batch reactor process feasibility for on-site remediation of coal conversion contaminated soil and leachates; anaerobic sequencing batch reactor treatment; polycyclic aromatic hydrocarbon sorption onto gasifier ash; and the thermodynamic effects of coal liquefaction process were reviewed. (White-Reimer-PTT)

W89-12528

POWER INDUSTRY WASTES.
Donohue and Associates, Inc., Sheboygan, WI.
M. L. Iwanski, and M. G. Browman.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 887-897, June 1989. 1 tab, 144 ref.

Descriptors: *Literature review, *Powerplants, *Hydroelectric plants, *Nuclear powerplants, *Wastewater treatment, Environmental regulations, Environmental effects, Ash disposal, Economic aspects.

Recent studies on power industry wastes are reviewed. In the area of environmental regulations there were significant additions and amendments to all of the major environmental protection laws in 1988, and an EPA report to congress recommended that high-volume coal combustion by-products from utilities such as fly ash, bottom ash, boiler slag, and flue gas desulfurization sludge, be regulated under EPA's Subtitle D (nonhazardous waste) program, and not under its hazardous waste program. Environmental assessments of hydroelectric power plants included a summary of the statutory framework for hydroelectric plant relicensing; an evaluation of several models for instream flow requirements below hydroelectric dams; examination of the application of the Index of Biotic Integrity method to existing stream data; a fishery status assessment of a major reservoir; and the results of a Bonneville Power Administration workshop on smoltification. Environmental assessments of fossil-fueled power plants included a review of published literature on economic measures and methods for assessing environmental damages; an approach for dealing with uncertainties when evaluating risks to the environment; cost-effective plans for controlling organic wastes; and fish protection at power plants. Ash disposal and use was reviewed in regard to its physical and chemical composition, leachability, economic utilization, and waste minimization strategy. Flue gas desulferization is also discussed. Nuclear power plants are discussed in regard to long-term effects of effluent from coastal and offshore plants; radiological assessment reports; and waste characterization, treatment, and disposal. Other topics reviewed are fluidized bed combustion, and cooling system and cooling water discharge. (White-Reimer-PTT)
W89-12529

METAL FINISHING AND PROCESSING.
CH2M/Hill, Reston, VA.
T. E. Higgins, and D. P. Desher.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 897-901, June 1989. 80 ref.

Descriptors: *Literature review, *Metal-finishing wastes, *Metallurgy, *Wastewater treatment, *Industrial wastes, Heavy metals, Environmental protection, Case studies, Precipitation, Ion exchange, Sorption, Reverse osmosis, Ultrafiltration, Electrodialysis, Waste disposal, Sludge management, Cyanide, Waste reduction.

Recent studies on metal finishing and processing are reviewed. The EPA has issued proposed rules on treatment for 24 hazardous wastes from the petroleum and steel industry, and a process for evaluating current effluent guidelines and regulations for industrial dischargers. Heavy metal treatment processes reviewed include precipitation processes, ion exchange, sorption processes, and a discussion of case studies. The following waste minimization processes were reviewed: (1) voluntary programs, (2) Congressional outlook, (3) industrial efforts, and (4) source reduction. Recovery techniques discussed were ion exchange, reverse osmosis, ultrafiltration, and electrodialysis. Treatment, disposal, and recovery techniques for sludge management and cyanide treatment are also discussed. (White-Reimer-PTT)
W89-12530

RADIOACTIVE WASTES.
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W89-12531

CONTROL OF PHOSPHORUS DISCHARGES: PRESENT SITUATION AND TRENDS.
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Sanitary Engineering.
P. Balmer, and B. Hultman.
Hydrobiologia HYDRB8, Vol. 170, p 305-319, December 1988. 6 fig, 2 tab, 73 ref.

Descriptors: *Phosphorus removal, *Chemical treatment, *Wastewater treatment, *Tertiary wastewater treatment, Cost analysis, Performance evaluation, Biological wastewater treatment, Activated sludge process, Bacteria, Management planning.

The dominant sources of phosphorus in municipal wastewater are excreta, 1.4 g P/per capita daily and detergents 0.6-2 g P/per capita daily. Detergent phosphorus can be substituted by nitrilotriacetic acid or zeolites, but if a substantial reduction of phosphorus in municipal waters is to be achieved, modifying the treatment process is necessary. Primary treatment by sedimentation removes only 10-15% and secondary biological treatment removes only 20-30% of the phosphorus in wastewater. If chemicals are added to the primary or secondary treatment stage of to a separate chemical stage, phosphorus can be efficiently removed. An effluent level of 0.8-1.5 g P/cu m is achieved easily and, with a filtration trap, it is possible to maintain 0.2 mg P/cu m in the effluent. Ferrous and ferric salts, alum, and lime are used widely as precipitants. By introducing anaerobic zones in the activated sludge process, it is possible to promote the growth of bacteria, which enhance biological phosphorus uptake. This makes it possible to achieve high phosphorus removal without, or at least with very small, chemical additions. The removal of phosphorus to a level of 0.8-1.5 g P/cu m increases cost 10-20% compared with conventional primary and secondary treatment. Higher removal efficiencies rapidly increase the marginal cost per marginal unit of P removed. At its present stage of development, biological phosphorus removal seems more sensitive to disturbances than chemical precipitation methods. Enhanced biological phosphorus removal still is not so well established that its cost-effectiveness can be evaluated. When local conditions are suitable, land treatment by irrigation or phytoculture-based phosphorus removal may be viable approaches. Phosphorus removal technology is still developing and new methods are under development. However, there is no indication that significantly more efficient or economical methods will emerge in the near future. When efficient phosphorus removal is implemented at municipal wastewater treatment plants, the relative importance of other urban phosphorus sources such as combined sewer overflows and storm runoff increases. (Rochester-PTT)
W89-12590

MATHEMATICAL INTERPRETATION OF AQUEOUS-PHASE OZONE DECOMPOSITION RATES.
Connecticut Univ., Storrs. Dept. of Civil Engineering.
D. Grasso, and W. J. Weber.
Journal of Environmental Engineering (ASCE) JOEEDR, Vol. 115, No. 3, p 541-559, June 1989. 7 fig, 2 tab, 40 ref.

Descriptors: *Wastewater treatment, *Water treatment, *Ozone, *Disinfection, *Mathematical studies, *Time series analysis, Physicochemical properties, Decomposition, Model studies, Kinetics, Chemical reactions, Disinfection, Oxidation, Rate constant, Autocatalytic reactions, Hydrogen ion concentration.

Ozone has been employed as an oxidant and disinfectant in water and wastewater applications since the early 1900s. Although the most fundamental aqueous-phase ozone reaction, its own decomposition, has been the subject of detailed study for more than 70 years, the form of the rate expression to be used for describing this reaction remains a matter of some controversy. Experimental data and hypothetical process behavior were analyzed in an attempt to elucidate the kinetics of aqueous phase ozone decomposition reactions. Three commonly accepted mathematical techniques (integral, differential, van't Hoff) for the analysis of rate data were employed. The results indicate that when single-order dependencies are used to model autocatalytic reactions, time-variable behavior of the rate constant and order is exhibited. This can partially explain existing controversy within the scientific community regarding the apparent order of ozone decomposition reactions. A simple autocatalytic rate expression is developed that accurately describes the decomposition rate data. The conclusions from the work have implications not only for development of an understanding of ozone decomposition kinetics, but for analysis of rate data derived from non-elementary reactions in general. Among the main conclusions are the fact that integral and differential techniques both resulted in a time-variable apparent reaction rate coefficient. Analysis of the data by the van't Hoff method resulted in a time-variable behavior of both the apparent rate order and rate coefficient. Two different types of autocatalytic reactions (hypothetical and trypsinogen) were investigated. Similar apparent order time-variable behavior were obtained at various initial product-to-reactant ratios. This was consistent with the results obtained in the ozone decomposition experiments, where the greatest fluctuation in apparent order occurred at the lowest pH values. (Friedmann-PTT)
W89-12616

STATISTICS-BASED APPROACH TO WASTEWATER TREATMENT PLANT OPERATIONS.
Wisconsin Univ., Madison. Dept. of Civil and Environmental Engineering.
P. M. Berthouex, W. Lai, and A. Darjatmoko.
Journal of Environmental Engineering (ASCE) JOEEDR, Vol. 115, No. 3, p 650-671, June 1989. 11 fig, 1 tab, 51 ref.

Descriptors: *Wastewater treatment, *Statistical methods, *Waste management, *Systems engineering, *Control systems, *Computers, Systematics, Graphical methods.

A convenient decision support system was developed to improve everyday operation and control of the wastewater treatment process. The goal is to help the operator detect problems in the process and select appropriate control actions. The system comprises subsystems for database management, data analysis including several statistical methods, and expert advice. The statistical methods investigated include construction of external reference distributions, computation of moving averages, graphical methods, discriminant functions for early detection of upsets and several kinds of control charts. The latter two methods are not built into the expert system. Reference distributions are used to help define fuzzy terms such as high and low for the conditions of the variables involved in the expert system control rules. The system is written in dBase-III and Lotus 1-2-3 and has a user-friendly interface for communication between the user and the system. (Author's abstract)
W89-12622

SODIUM MOLYBDATE INHIBITS SULPHATE REDUCTION IN THE ANAEROBIC TREATMENT OF HIGH-SULPHATE MOLASSES WASTEWATER.
Agricultural and Food Research Council, Norwich (England). Norwich Lab.
V. K. Yadav, and D. B. Archer.
Applied Microbiology and Biotechnology AMBIDG, Vol. 31, No. 1, p 103-106, July 1989. 2 fig, 20 ref.

Descriptors: *Inhibitors, *Sulfates, *Food-processing wastes, *Wastewater treatment, *Industrial wastes, *Anaerobic digestion, *Methane, Molasses, Filtration, Sulfate reduction, Sodium molybdate, Chemical oxygen demand, Methanogenesis, Water pollution prevention, Filtration, Adaptation.

Molasses is used in ethanol, potable spirit, and yeast biomass production. These processes produce large amounts of wastewaters that are treated by anaerobic digestion in order to avoid environmental pollution and to produce methane which can be used as fuel. The presence of high sulfate concentrations during anaerobic digestion of these wastes creates particular problems because sulfate encourages the growth of sulfate-reducing bacteria which leads to lower methane yields. This study examines the use of sodium molybdate to inhibit sulfate reduction without adversely affecting methanogenesis. Three concentrations (0.1 mM, 0.5 mM, and 1.0 mM) of sodium molybdate were added to continuously fed anaerobic upflow filters (1.0l) treating a high-sulfate molasses wastewater which contained approximately 27.0 g chemical oxygen demand/L and 6.0 g sulfate/L. Sodium molybdate (0.1 mM) did not inhibit sulfate reduction by the filter. Higher concentration (0.5 mM and 1.0 mM) inhibited sulfate reduction but methanogenesis was also slightly affected. The microflora of the filters adapted to the continuous presence of sodium molybdate (1.0 mM) and sulfate reduction was then evident. Addition of a higher concentration of sodium molybdate was then necessary to inhibit sulfate reduction but methanogenesis was also adversely affected. (White-Reimer-PTT)
W89-12665

TREATMENT OF VERMICELLI WASTEWATER BY AN ACID-TOLERANT STARCH-DEGRADING YEAST.
Feng Chia Univ., Taichung (Taiwan). Dept. of Environmental Science.
T. Hu.
Biological Wastes BIWAED, Vol. 28, No. 3, p 163-174, 1989. 3 fig, 5 tab, 18 ref. National Science Council grant NSC 75-0409-B035-01 and NSC 76-0409-B035-01B.

Descriptors: *Starch, *Industrial wastewater, *Biological wastewater treatment, *Wastewater treatment, *Food-processing wastes, *Yeasts, Acid tolerance, Protein hydrolysis, Starch-degradation, Biochemical oxygen demand, Chemical oxygen demand, Hydraulic retention time, Volumetric loading, Solid loading.

Wastewater discharged from vermicelli factories has a high concentration of starch and protein, with chemical oxygen demand (COD) ranging from 30,000 mg/L to 60,000 mg/L and biochemical oxygen demand (BOD) ranging from 24,000 to 44,000 mg/L. Because of these high concentrations the wastewater is considered to be heavy and particulated. Wild yeasts were isolated from 117 soil samples, using the pour-plate method, and applied to treat the vermicelli wastewater. The ability of isolates to reduce the COD of vermicelli wastewater was tested and ten isolated strains were obtained that had the ability to degrade starch, hydrolyze protein, and tolerate lactic acid. Treatment of wastewater from a vermicelli factory with an adjusted C:N:P ratio using the isolated yeasts in batch culture showed that two strains could reduce soluble COD by 79-83%. When the hydraulic retention time and solid retention time were kept at 7.14 days, using a semi-continuous culture, the solid loading was 0.48 g COD/g MLSS per day, volumetric loading was 1.03 kg COD/cu m per day, and the COD removal was about 92%. (Author's abstract)
W89-12666

EFFECT OF NONLINEAR FLOW PROPAGATION ON THE REAL-TIME CONTROL OF RUNOFF IN A COMBINED SEWER SYSTEM (EFFET DE LA PROPAGATION NON LINEAIRE DES DEBITS SUR LE CONTROLE EN TEMPS REEL DES DEBORDEMENTS DE RESEAUX UNITAIRES).
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
L. Wilson, D. Isabel, and J. P. Villeneuve.
Canadian Journal of Civil Engineering CJCEB8, Vol. 16, No. 2, p 119-123, April 1989. 4 fig, 1 tab, 13 ref. English summary.

Descriptors: *Model studies, *Operating policies, *Runoff, *Sewer systems, *Combined sewers, Sewer overflow, Control strategies, Real-time control, Nonlinear programming, Discharge propagation, Simulation, Optimization.

A number of reports on simulations of real-time control of combined sewer system runoff have been published. Most of the control strategies suggested use linear models to calculate discharge routing. We used a nonlinear model for discharge routing and some of our findings differ from those obtained in earlier studies. In particular, it appears that the prediction horizon used for control optimization could be favorably shorter than the time of system flow-through. (See also W89-12675) (Author's abstract)
W89-12673

BATCH STUDIES ON SEPTIC TANK EFFLUENT TREATMENT USING PEAT.
Regina Univ. (Saskatchewan). Faculty of Engineering.
T. Viraraghavan, and A. Ayyaswami.
Canadian Journal of Civil Engineering CJCEB8, Vol. 16, No. 2, p 157-161, April 1989. 6 fig, 5 tab, 11 ref.

Descriptors: *Wastewater treatment, *Septic tanks, *Septic wastewater, *Peat, Chemical oxygen demand, Biochemical oxygen demand, Nutrients, Bioindicator, Adsorption, Leaching, Model studies.

Batch studies were conducted to determine the efficiency of Saskatchewan horticultural peat to remove biochemical oxygen demand (BOD), chemical oxygen demand (COD), phosphorus, nitrogen, and indicator microorganisms from septic tank effluent. Batch kinetic and adsorption studies were conducted using a jar test apparatus at approximately 21 C with six concentrations of peat in the range from 0.01 to 2.5 g/100 mL. Results of the studies showed that peat was effective in adsorbing 35-50% of dissolved BOD, COD, and organic carbon from the septic tank effluent and in removing indicator microorganisms to the extent of 45-70%. An adsorption isotherm analysis showed that, depending upon the concentration range of peat which is mixed with the septic tank effluent, different isotherms may be applicable for the pollution parameters considered. These models are useful in quantifying the rate of adsorption and the equilibrium capacities and, therefore, aid in the design of an adsorption column and provide an initial estimate of the time a peat bed of a certain volume can effectively remove pollutants. The studies showed that peat has the potential to be used as a medium for septic tank effluent treatment in areas with high water table and with bedrock at shallow depths. Because of leaching of pollutants from peat in the 2-h batch studies, it is necessary to conduct long-term column studies to observe the length of time leaching continues and to evaluate the performance of a peat filtration system under dynamic conditions. (White-Reimer-PTT)
W89-12674

QUALITY-DISCHARGE MODELS IN A COMBINED SYSTEM DURING A RAINY PERIOD (MODELES DEBIT-QUALITE DANS UN RESEAU UNITAIRE EN PERIODE DE PLUIE).
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Isabel, L. Wilson, and J. P. Villeneuve.
Canadian Journal of Civil Engineering CJCEB8, Vol. 16, No. 2, p 197-200, April 1989. 3 fig, 1 tab, 9 ref. English summary.

Descriptors: *Suspended solids, *Flow discharge, *Rainfall, *Urban runoff, *Combined sewers, *Combined sewers overflow, *Model studies, Quebec, Control systems, Automation.

Several simple quality-discharge models (concentration of suspended matter) are proposed for the automatic real-time control of combined sewer system overflows. These models are calibrated and verified with data supplied by the City of Quebec. They can be useful in setting up a control system which takes into account quality without using real-time measures since their forecasting capability is interesting even if not perfect. (See also W89-12673) (Author's abstract)
W89-12675

IMPLEMENTING A SCADA SYSTEM--TRIALS, TRIBULATIONS, TRIUMPH.
Anne Arundel County Dept. of Utilities, Glen Burnie, MD.
J. J. Dipietro.
Public Works PUWOAH, vol. 129, No. 6, p 82-84, June 1989.

Descriptors: *Control systems, *Remote sensing, *Sewer systems, *Telemetry, *SCADA, *Monitoring, *Maryland, *Chesapeake Bay, *Data acquisition, *Data transmission, Automation, Installation, Maintenance, Pumping plants, Training, Interference, Field transmitters.

Leisure activities along the 400 miles of shoreline on Chesapeake Bay and its tributaries in Anne Arundel County, Maryland were threatened in 1983 when there were 52 sewage spills into tidal creeks, rivers, and the Bay. A system was proposed to monitor sewage pumping stations and water reclamation facilities by radio wave transmissions. Information from the remote facilities would be processed, analyzed, and displayed through a SCADA (supervisory control and data acquisition) system. Problems with the initial system were encountered as a result of false alarms during electrical power outages, loss of operational efficiency and cost effectiveness, and time lapse problems between polls. An improved and expanded system was implemented that used multiple radio frequencies and repeaters located on top of two water storage facilities and could monitor both status and analog points as well as converting and storing flow measurement information received from field transmitters. During the 18 month installation period many unanticipated problems arose; generally in the areas of system installation and system communications which include: installation and operation of the mapboard; foliage interference around pumping stations; path reliability problems between the repeater and the control unit; interference between radio frequencies; and external interference problems ranging from paging systems to microphones close to the repeaters. Despite all the problems, the value of the early warning system is apparent and has prevented several pumping station failures. Maintaining and operating the system requires training in system operation, system management/database programming, and field technician training. (White-Reimer-PTT)
W89-12709

REGIONAL APPROACH TO SLUDGE MANAGEMENT.
Dufresne-Henry, Inc., North Springfield, VT.
For primary bibliographic entry see Field 5E.
W89-12733

DEGRADATION OF MALATHION BY MICROORGANISMS ISOLATED FROM INDUSTRIAL EFFLUENTS.
Industrial Toxicology Research Centre, Lucknow (India). Developmental Toxicology Div.
A. K. Singh, and P. K. Seth.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 43, No. 1, p 28-35, July 1989. 6 fig, 1 tab, 8 ref.

Descriptors: *Microbial degradation, *Biological wastewater treatment, *Pesticides, *Wastewater treatment, *Effluents, *Industrial wastes, *Malathion, *Microorganisms, Biodegradation, Enrichment, Degradation, Metabolites, Isolation, Bacteria, Alcohols, Aerobic conditions, Anaerobic conditions, Growth, Temperatures, Hydrogen ion concentration, Pulp wastes, Toxicity, Substrates.

Attempts were made to isolate a microorganism capable of readily degrading high concentrations of malathion from industrial effluents using an enrichment technique and to isolate and identify the major metabolites of malathion formed during biodegradation of the pesticide. Malathion degrading organisms were isolated from industrial (paper mill) effluents. The bacteria strain selected (M-3) was tested for its ability to degrade malathion. The

degradation of malathion by M-3 strain was tested in the presence and absence of an additional carbon source (ethanol under aerobic conditions). No degradation of malathion was observed in the absence of ethanol. Among the cosubstrates studied (glucose, ethanol and succinate), ethanol was the best in supporting the growth of the strain. The maximum growth of the strain was observed when the concentration of ethanol in the medium was 1.0%. Under anaerobic conditions, very little growth of the bacterium was observed. The bacterium was able to grow between 20 C and 45 C with optimum at 30 C, and between pH 5.5 and 9.5 with optimum around 7.0. Among the various alcohols tested for the growth of M-3 strain, only ethanol was used as a carbon and energy source while the other alcohols (methanol, iso-propanol, n-butanol, tert-butanol, iso-amylalcohol) did not support the growth of the bacterium. The papermill effluent contained microorganisms capable of readily degrading malathion cometabolically up to a concentration of 150 ppm in the presence of ethanol as a cosubstrate. A decrease in the growth of the microorganism at a concentration of 200 ppm of malathion indicates that the pesticide is toxic to the microorganism at higher concentration. The isolation of the M-3 strain capable of readily degrading high concentrations of malathion, provides hope for the utilization of this strain in biodegradation of malathion in industrial effluents. (Miller-PTT)
W89-12735

EVALUATION OF ATP PHOTOMETER FOR TOXICITY TESTING USING MICROTOX LUMINESCENT BACTERIAL REAGENT.
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. Awong, G. Bitton, B. Koopman, and J. L. Morel.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 43, No. 1, p 118-122, July 1989. 1 tab, 15 ref.

Descriptors: *Measuring instruments, *Adenosine triphosphate, *Microtox assay, *Wastewater analysis, *Wastewater treatment, *Activated sludge, *Photometry, *Toxicity, Bioluminescence, Performance evaluation, Wastewater facilities, Florida, Median tolerance limit, Correlation analysis, Comparison studies, Statistical studies, Statistical analysis, Temperature control, Inhibition.

The performance of a conventional ATP photometer was assessed in comparison to the Microtox photometer for measuring inhibition of the bioluminescence of Photobacterium phosphoreum in the presence of toxic pure chemicals and toxic wastewater. The Buckman collection and activated sludge treatment system in Jacksonville, FL was used as a model wastewater system. Samples were obtained from the collection system, plant influent and secondary effluent before chlorination. The EC50s obtained for five chemicals with the ATP photometer were generally lower than those obtained with the Microtox photometer. Percent inhibition values were determined for 44 wastewater samples that were collected over a 3 month period. Highly significant correlations ($P < 0.01$) were obtained between the two methods when comparing percent inhibition at 5 minutes. EC50s for the two methods were calculated for the 14 samples that showed percent inhibitions of greater than 20% at a wastewater concentration of 45%. highly significant correlations ($P < 0.01$) were obtained between the data sets obtained with either a 5-minute contact period or 15-minute contact period. Mean differences between neither the 5-minute EC50s nor the 15-minute EC50s were significant. The highly significant correlations found between the Microtox Analyzer and the ATP Photometer and absence of significant differences between percent inhibitions or EC50s found via the two methods indicate that commercially available photometers could indeed be used in lieu of the Microtox Analyzer. A significant advantage of assay with the ATP photometer is the need for smaller volumes of bacterial reagent in each cuvette. However, the problem of temperature control must be addressed. (Miller-PTT)
W89-12738

SUITABILITY OF ION EXCHANGE RESINS FOR THE REMOVAL OF CADMIUM FROM WASTEWATERS: PART II. EVALUATION OF ADSORBENTS.
Villanova Univ., PA. Dept. of Chemical Engineering.
V. L. Punzi, and D. R. Hoffman.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 22, No. 4, p 7-9, July 17, 1989. 1 tab.

Descriptors: *Wastewater treatment, *Resins, *Ion exchange, *Cadmium, *Adsorption, Heavy metals, Activated carbon.

A series of investigations have been undertaken to study the suitability of ion exchange resins to chemically adsorb cadmium (II) from industrial wastewaters. The results of a series of batch mode experiments, performed to determine the rate of cadmium adsorption as a function of both wastewater pH and specific type of adsorbent used, are presented. Both the short-term adsorption tendency and the long-term rate of adsorption were used to comparatively evaluate four ion exchange resins and one activated carbon. Activated carbon was included because earlier studies have demonstrated its suitability in such an application. Of the five adsorbents tested, only Rohm and Haas IRC-718 dramatically reduced the cadmium (II) concentration in the wastewater, and achieved this reduction in a short time period. This resin removed 93% of the cadmium (II) in four minutes. It is concluded that ion exchange resins are suitable adsorbents for cadmium (II) removal and that the IRC-718 resin in particular should be tested further. (Author's abstract)
W89-12750

EVALUATION OF THE POLYMER FEED AND SLUDGE DEWATERING PRACTICES AT THE CLAIRTON MUNICIPAL AUTHORITY SEWAGE TREATMENT FACILITY.
Clairton Municipal Authority, PA.
J. A. Drnach.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 22, No. 4, p 13-18, July 17, 1989. 2 fig, 3 tab, 9 ref.

Descriptors: *Wastewater treatment, *Solids capture processes, *Sludge drying, *Polymers, Computers, Lotus 1-2-3.

The ability to improve solids capture in sludge dewatering by altering various control and design characteristics of a dry polymer feed system was studied at the Clairton Municipal Authority (CMA) Waste Water Treatment Facility. Process rates, constants and yields were derived from field measurement and experimental data and monitored using LOTUS 1-2-3 in the Authority's IBM Personal System 2/50 Computer. Changes in the polymer feed and aging practices were found to be effectively reduce polymer consumption to the present rate of 3-5 lbs/dry tons sludge processed, while maintaining a better than 99% capture of total feed solids. Contributing to the reduction of polymer used was maintenance of a high feed solids rate to the centrifuge. Maintaining the lower polymer usage was dependent upon the operator's ability to adjust polymer feed rates to meet changes in feed sludge densities. (Author's abstract)
W89-12751

SLURRY COMPOSTING OPTIONS.
Cordoba Univ. (Spain). Dept. of Agricultural Chemistry and Pedology.
J. L. Gonzalez, M. Medina, and I. C. Benitez.
Biocycle BCYCDK, Vol. 30, No. 7, pp. 53-55, July 1989. 3 fig, 2 tab, 16 ref.

Descriptors: *Animal wastes, *Waste disposal, *Soil amendments, *Slurries, *Composting, *Wastewater disposal, *Wastewater. *Manure, Hydrogen ion concentration, Metals, Organic carbon, Nitrogen, Cation exchange, Ammonia, Nitrates, Agronomy.

Pig slurry can be composted and used as an agricultural soil conditioner and corrector. 80 percent pig slurry was mixed with either 10 percent poultry manure and 10 percent clayey earth (Mixture A) or 10 percent cattle manure and 10 percent clayey earth (Mixture B). Mixtures were turned weekly and pH, organic carbon, nitrogen, and cation exchange capacity were determined every 10 days. P, K, Ca, Mg, Na, Fe, Cu, Mn, Zn, Cd, Ni and Pb were measured in the final contents. Measured parameters remained constant after the 50th day of fermentation, reflecting stabilized composts after that date. Organic N increased throughout the process, with the final contents of mixture A containing 1.50 percent and mixture B containing 1.18 percent. Ammonia N levels decreased, while nitrate N levels increased in both mixtures. No nitrite build-up was observed. These organic N and nitrate N levels suggest good long-term and short-term nitrogen efficiency, respectively. Organic matter fractions reveal more intense mineralization than humification. Agrochemical and hydrophysical properties of the final compost products ensure good agronomical qualities for both mixtures, but mixture A, containing 10 percent poultry manure, appears to be better. (Mertz-PTT)
W89-12767

INFLUENCE OF EXTERNAL ORTHOPHOSPHATE CONCENTRATIONS ON SOME KINETIC PROPERTIES OF ACTIVATED SLUDGE IN AN ANAEROBIC-AEROBIC SYSTEM.
Konishi Co. Ltd., Tokyo (Japan). Tokyo Research Lab.
A. Hiraishi, K. Masamune, and H. Kitamura.
Journal of Fermentation and Bioengineering JFBIEX, Vol. 67, No. 4, 1989. 6 fig, 1 tab, 16 ref.

Descriptors: *Activated sludge, *Anaerobic conditions, *Aerobic conditions, *Orthophosphates, Polyphosphates, Anaerobic-aerobic sludge reactors, Kinetics, Anaerobic-aerobic system, Organic carbon, Inhibition.

The addition of high levels of orthophosphate to the mixed liquor of activated sludge in a laboratory-scale batch anaerobic-aerobic system inhibited organic carbon uptake during the anaerobic phase. The degree of inhibition reached the maximum with orthophosphate at a concentration of 3 mM and above. When the external orthophosphate concentration was low, anaerobiosis induced the simultaneous occurrence of an increase of effluent orthophosphate and a decrease of the phosphorus content of sludge, as usual. The decrease in the phosphorus level of sludge was due mainly to polyphosphate degradation. The initial presence of 3 mM orthophosphate, however, suppressed both anaerobic orthophosphate release and polyphosphate degradation. These results suggest that an excess of external orthophosphate inhibits polyphosphate degradation and the resultant energy generation in sludge under anaerobic conditions, whereby anaerobic organic matter removal may be suppressed. The long-term operation of the anaerobic-aerobic system at high orthophosphate-loading rates resulted in producing sludge incapable of anaerobic orthophosphate release and aerobic enhanced orthophosphate removal. (Author's abstract)
W89-12774

REMOVAL OF DIMETHYL SULFIDE, METHYL MERCAPTAN, AND HYDROGEN SULFIDE BY IMMOBILIZED THIOBACILLUS THIOPARUS TK-M.
Fermentation Research Inst., Yatabe (Japan).
Y. Tanji, T. Kanagawa, and E. Mikami.
Journal of Fermentation and Bioengineering JFBIEX, Vol. 67, No. 4, pp. 280-285, 1989. 5 fig, 1 tab, 10 ref.

Descriptors: *Wastewater treatment, *Odor control, *Thiobacillus, *Dimethyl sulfide, *Methyl mercaptan, *Hydrogen sulfide, *Biological treatment, Bacteria, Decomposition, Biological deodorizing.

Cells of Thiobacillus thioparus TK-m were immobilized on cylindrical porous polypropylene pellets (5 mm x 5 mm) which were packed in an acrylic

cylinder of 50 mm inner diameter up to the height of 800 mm. When a sulfur-containing malodorous gas was charged to this packed tower at the superficial velocity of 0.1 m/s, maximum loading capacity (mmol/l x d) for a malodorous gas to attain the removal rate of 95 percent or more was: 3.65 for dimethyl sulfide, 8.74 for methyl mercaptan, and 17.36 for hydrogen sulfide. At this time, the inlet concentration (microliter/l) of the malodorous compound was: 7.44 for dimethyl sulfide, 17.8 for methyl mercaptan, and 35.4 for hydrogen sulfide. For every compound, higher loading resulted in greater removal quantities. The removal rate of dimethyl sulfide was not overly affected by the presence of a large amount of easily decomposable hydrogen sulfide. (Author's abstract)
W89-12775

IMPACT OF WATER QUALITY ON FISH PRODUCTION BASED ON EGYPTIAN AND ISRAELI PRACTICES.
Hebrew Univ. of Jerusalem (Israel). Graduate School of Applie Science and Technology.
For primary bibliographic entry see Field 8I.
W89-12782

MINIMISATION OF MICROBIOLOGICAL HAZARDS ASSOCIATED WITH LATRINE WASTES.
Robens Inst. of Industrial and Environmental Health and Safety, Guildford (England).
D. Wheeler, and R. F. Carroll.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 35-42, July 19, 1989. 2 tab, 14 ref.

Descriptors: *Domestic wastes, *Septic sludge, *Sludge utilization, *Public health, *Sanitation, *Enteric bacteria, *Enteroviruses, *Rotaviruses, *Parasites, *Developing countries, Botswana, Ascaris, Taenia, Schistosoma.

Investigations of latrine wastes in Botswana were undertaken to verify that sludge stored in a pit latrine chamber for at least one year does not constitute an unacceptable microbiological hazard on handling or reuse. Levels of fecal bacteria, Ascaris, Taenia, Schistosoma and human enteric viruses in sludges which had been stored for periods of more than one year were compared with levels in improperly stored sludges. In all cases, the importance of long-term storage was confirmed. However, it is noted that substantial sociological and educational inputs are required if latrine users are to obtain the maximum health and economic benefits of latrine sanitation and sludge reuse, particularly in cultures where there is traditionally little interest in such practices. (Author's abstract)
W89-12783

GIARDIA AND VIRUS MONITORING OF SEWAGE EFFLUENT IN THE STATE OF ARIZONA.
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 3C.
W89-12784

INDIGENOUS COLIPHAGES AND RNA-F-SPECIFIC COLIPHAGES ASSOCIATED WITH SUSPENDED SOLIDS IN THE ACTIVATED SLUDGE PROCESS.
Tokyo Univ. (Japan). Dept. of Urban Engineering.
A. Ketratanakul, and S. Ohgaki.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 73-78, July 19, 1989. 5 fig, 1 tab, 13 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Suspended solids, *Bacteriophage, *Bioindicators, Escherichia coli, Wastewater analysis.

The occurrence of indigenous coliphages and RNA-F-specific coliphages associated with suspended solids in the activated sludge process was investigated using Escherichia coli K-12, F+(A/lambda) as the host strain. Indigenous coliphages and RNA-F-specific coliphages adsorbed to suspended solids were detected in significant numbers in raw sewage. The adsorbed phages ranged from 12-30% of the total indigenous coliphages in the raw sewage. Of these adsorbed phages, 6-20% were RNA-F-specific coliphages. Over 97% of the coliphages in the aeration tank were associated with suspended solids and most of these were RNA-F-specific coliphages. (Author's abstract)
W89-12789

WASTEWATER TREATMENT FOR EFFLUENT REUSE: LIME-INDUCED REMOVAL OF EXCRETED PATHOGENS.
Leeds Univ. (England). Dept. of Civil Engineering.
M. P. Gambrill, D. D. Mara, J. I. Oragui, and S. A. Silva.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 79-84, July 19, 1989. 2 fig, 5 tab, 13 ref.

Descriptors: *Water reuse, *Irrigation water, *Wastewater treatment, *Wastewater irrigation, *Enteric bacteria, *Coliforms, *Parasites, *Viruses, *Enteroviruses, *Rotaviruses, *Sedimentation, *Lime, Chemical oxygen demand, Suspended solids, Clarifloc treatment.

High quality effluents suitable for crop irrigation can be produced by lime and Clarifloc treatment of raw domestic wastewaters: in laboratory jar-test experiments the average percentage removals were 99.999 for fecal coliforms, 99-99.9 for salmonellae, 99.9-100 for total parasites and 99-99.9% for rotavirus. The average removals of COD and suspended solids were 79-87 and 97% respectively. Clarifloc treatment was marginally better than that achieved by lime. (Author's abstract)
W89-12790

NEW TECHNIQUE FOR THE ENUMERATION OF ROTAVIRUSES IN WASTEWATER SAMPLES.
Leeds Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W89-12793

REMOVAL EFFICIENCIES OF INDICATOR MICRO-ORGANISMS IN SEWAGE TREATMENT PLANTS.
Iwate Univ., Morioka (Japan). Dept. of Civil Engineering.
T. Omura, M. Onuma, J. Aizawa, T. Umita, and T. Yagi.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 119-124, July 19, 1989. 4 fig, 1 tab, 8 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Trickling filters, *Coliforms, *Enteric bacteria, *Bacteriophage, Disinfection, Chlorination.

The removal of coliform bacteria, enterococcus bacteria, and coliphages in two sewage treatment plants, one using the activated sludge process and the other using a high-rate trickling filter, was investigated over a period of one year. Coliform and enterococcus bacteria were removed with equal efficiency by the two plants, but coliphages were removed more efficiently by the activated sludge process. Experiments on the mechanism of removal revealed that it was mainly due to adsorption on the activated sludge and on the slime in the trickling filter. Die-off of the microorganisms seemed to play a minor role in the reduction in counts. The treated sewage was disinfected by chlorination prior to discharge into the receiving water. No coliforms were detected in the chlorinated effluents when they had chlorine residuals in the range of 0-1.521 mg/L. However, enterococci were detected when chlorine residuals dropped below 0.598 mg/L. Coliphages proved to be the most resistant organisms and they were generally detected throughout the range of chlorine residuals encountered. (Author's abstract)
W89-12796

AEROSOLIZED ENTERIC BACTERIA AND VIRUSES GENERATED BY SPRAY IRRIGATION OF WASTEWATER.
Hebrew Univ. of Jerusalem (Israel). Graduate School of Applie Science and Technology.
For primary bibliographic entry see Field 5E.
W89-12798

INACTIVATION OF HEALTH-RELATED MICROORGANISMS IN WATER BY DISINFECTION PROCESSES.
North Carolina Univ., Chapel Hill. School of Public Health.
M. D. Sobsey.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 179-195, July 19, 1989. 7 tab, 130 ref.

Descriptors: *Water treatment, *Disease, *Drinking water, *Disinfection, *Wastewater treatment, Enteric bacteria, Viruses, Enteroviruses, Parasites, Bactericides, Viricides, Chlorine, Chloramines, Chlorine dioxide, Chlorination, Public health, Reviews.

The recent literature on disinfection of health-related microorganisms in water and wastewater is reviewed. There is now considerable evidence that traditional microbial indicators of water and wastewater quality, e.g. total and fecal coliform bacteria, are inadequate to predict the presence or disinfection responses of several important, newly recognized bacterial, viral and protozoan pathogens. The response to disinfection of waterborne microbial pathogens and potential indicators of recent recognition and public health concern is emphasized. These organisms include heterotrophic plate count bacteria, frank and opportunistic bacterial pathogens, e.g. Campylobacter jejuni, Yersinia enterocolytica, non-tubercular mycobacteria, Legionella spp. and pseudomonads; coliphage indicators and enteric viruses, e.g. hepatitis A virus, rotaviruses and Norwalk virus; and protozoan pathogens, e.g. Giardia lamblia, Cryptosporidium, and the free-living amoeba (e.g. Acanthamoeba spp. and Negleria spp.). The response of these organisms to widely used, traditional disinfectants, e.g. free and combined chlorine, and to disinfectants of more recent interest, e.g. ozone, chlorine dioxide and UV light, are reviewed. An attempt was made to identify the variety of factors influencing disinfection efficiency, especially those that interfere with disinfection. It is apparent that traditional microbial indicators, e.g. total and fecal coliforms, are more sensitive to disinfection than such pathogens of recent concern as mycobacteria, enteric viruses and protozoan cysts. Therefore, efforts must be continued to find more reliable indicators of disinfection efficiency and microbial water quality and improved methods for water and wastewater disinfection. (Author's abstract)
W89-12806

STATISTICS OF MICROBIAL DISINFECTION.
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, and B. Heller.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 197-201, July 19, 1989. 1 tab, 37 ref.

Descriptors: *Water treatment, *Wastewater treatment, *Disinfection, Kinetics, Statistical analysis, Monte Carlo method.

Engineering adequate disinfection processes and assessing risks associated with various disinfection options requires knowledge of the kinetics of microbial inactivation as a function of design variables (e.g. dose, contact time). Often such information is obtained in batch studies and extrapolated to design conditions. By Monte Carlo techniques, it is shown that the use of a direct maximum likelihood evaluation for two types of data normally encountered, counts (PFU and CFU) and dilution experiments (MPN), leads to estimates of microbial inactivation rate parameters having lower bias and variance than other data reduction normally employed. This paper reviews the methodology of this technique and provides the theory for the computation of confidence limits for parameter estimates, and discusses how the data may be checked for consistency (goodness of fit determination). (Author's abstract)
W89-12807

DISINFECTION OF SEWAGE EFFLUENT WITH PERACETIC ACID.
Interox S.A., Widnes (England).
M. G. C. Baldry, and M. S. French.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 203-206, July 19, 1989. 3 tab.

Descriptors: *Wastewater treatment, *Disinfection, *Peracetic acid, *Chlorine, *Chlorine dioxide, *Chlorination, *Coliforms, Activated sludge process, Percolating filter bed.

Novel products based on peracetic acid (PAA) have recently been developed for the disinfection of sewage and sewage effluents. The efficacy of such products has been assessed under both laboratory and operational conditions. Comparative laboratory studies of the effects of PAA, chlorine dioxide and chlorine on indicator bacteria in secondary sewage effluent have shown PAA to be a viable alternative to these halogen biocides. In a trial carried out at two small rural works, PAA was dosed into secondary effluent from either an activated sludge plant or a percolating filter bed prior to tertiary lagoon treatment. Low levels of PAA greatly enhanced the natural decline in coliform levels across the lagoon, enabling much lower concentrations of bacteria to be discharged into the receiving streams. In another trial, secondary effluent from an activated sludge plant was treated before discharge into a stream leading to the sea. Coliform concentrations were greatly reduced along the watercourse downstream from the plant. (Author's abstract)
W89-12808

COMPARATIVE RESISTANCE OF BACTERIOPHAGES ACTIVE AGAINST BACTEROIDES FRAGILIS TO INACTIVATION BY CHLORINATION OR ULTRAVIOLET RADIATION.
Barcelona Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W89-12811

RNA COLIPHAGE QBETA AS A BIOINDICATOR OF THE ULTRAVIOLET DISINFECTION EFFICIENCY.
Tokyo Univ. (Japan). Dept. of Urban Engineering.
N. Kamiko, and S. Ohgaki.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 227-231, July 19, 1989. 9 fig, 6 ref.

Descriptors: *Water treatment, *Wastewater treatment, *Disinfection, *Ultraviolet radiation, *Bacteriophage, Kaolin, Activated sludge, Suspended solids.

F-specific RNA coliphage QBeta was used for evaluating the factors (UV absorbents and suspended solids) affecting UV disinfection efficiency in water/wastewater treatment. QBeta was an adequate bioindicator for measuring actual UV intensity profiles because of its high consistency and reproducibility. The effect of suspended solids (kaolin and activated sludge) on UV disinfection efficiency depended on the UV reflection characteristics of suspended solids. (Author's abstract)
W89-12812

STUDY OF MICROBIAL QUALITY AND TOXICITY OF EFFLUENTS FROM TWO TREATMENT PLANTS USED FOR IRRIGATION.
Universidad Politecnica de Valencia (Spain). Dept. of Hydraulic and Environmental Engineering.
I. Amoros, J. L. Alonso, and I. Peris.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 243-246, July 19, 1989. 2 fig, 2 tab, 17 ref.

Descriptors: *Wastewater treatment, *Water reuse, *Wastewater utilization, *Irrigation, *Water quality, *Bacterial analysis, *Public health, Coliforms, Streptococcus, Salmonella, Vibrio.

A study of the health risks associated with treated wastewater to be reused for irrigation of grapes was carried out. Effluents from two treatment plants were analyzed: Effluent 1, from a mixed industrial and urban treatment plant (which was stored mixed with freshwater in a ratio of 1:1); and Effluent 2, from an urban treatment plant. Total coliforms, fecal coliforms, and fecal streptococci levels were used as indicators of the health risks of the grapes. Effluent 1 showed the highest levels of fecal pollution with maximum values, enumerated by the most probable number technique, above 10 billion for total coliforms, 10 million for fecal coliforms, and 10,000 for fecal streptococci. Effluent 2 had lower levels of fecal pollution than Effluent 1, with maximum values above 10 million for total coliforms, 1 million for fecal coliforms, and 100 for fecal streptococci. The different levels of fecal pollution found in the wastewaters during the various months and the fact that Salmonella and Vibrio cholerae were found on only two occasions indicate that the health risks of wastewater used for irrigation depend not only on the season of the year and on the temperature, but also on the length of time that the wastewater is stored. Despite the high levels of fecal indicators found in the wastewaters and the positive results of Salmonella and V. cholerae, bacteriological examinations of the grapes gave negative results in all tests. While the bacteriological counts for the wastewaters were higher than those recommended by the EPA (1000 fecal coliforms/100 ml) for irrigation water, it does not appear that the consumption of grapes irrigated with these wastewaters constitutes a health risk. (Sand-PTT)
W89-12814

PLASMID-DETERMINED RESISTANCE TO SILVER IN ENTEROBACTER CLOACAE ISOLATED FROM SEWAGE.
Yamanashi Medical Coll. (Japan). Dept. of Environmental Health.
For primary bibliographic entry see Field 5C.
W89-12822

VIRUSES ISOLATED FROM ACTIVATED SLUDGES, 1984-1986.
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
M. Nashida, E. Shimohara, S. Sugishima, and M. Kaneko.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 279-282, July 19, 1989. 3 fig, 2 tab, 5 ref.

Descriptors: *Culturing techniques, *Viruses, *Activated sludge, *Wastewater treatment, Enteroviruses, Adenoviruses, Reoviruses, Poliovirus, Echovirus, Coxsackie virus.

In a 3-year survey of viruses in activated sludges from sewage treatment plants, during 1984-86, enteroviruses (polio, coxsackie B and echo), adenoviruses and reoviruses were detected. Viruses were eluted from sludges by the method using 3% beef extract (pH 9). Viruses (663 total) were isolated from 276 samples tested. Of these samples, 266 (96%) were positive for one or more viruses. The number of viruses isolated could be identified as 104 polioviruses, 188 coxsackie B viruses, 65 echoviruses, 150 adenoviruses, 137 reoviruses and 19 unidentified viruses. Seasonal fluctuations of enteroviruses isolated were observed. The cell culture systems for isolation of viruses were BGM, Vero, FL, HeLa, primary African green monkey kidney and RD-18S (clone cell line of RD cells); BGM cells were useful for isolation of polioviruses and coxsackie B viruses; Vero cells were of use for isolation of reoviruses; RD-18S cells were useful for echoviruses; FL and HeLa could be effectively used for adenoviruses. Virus concentrations in sludges were assayed by the plaque method using BGM cells. Mean concentration values for enteroviruses were 1.4 and 7.4 pfu/ml for 1985 and 1986, respectively, with ranges of 0.2-3.8 and 0.7-21.1 pfu/ml. (Author's abstract)
W89-12823

IMPACT OF WASTEWATER TREATMENT ON HELMINTH EGGS.
Nancy-1 Univ. (France). Faculte de Pharmacie.
J. Schwartzbrod, J. L. Stien, K. Bouhoum, and B. Baleux.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 295-297, July 19, 1989. 2 tab, 13 ref.

Descriptors: *Water reuse, *Wastewater utilization, *Irrigation water, *Wastewater treatment, *Activated sludge, *Sand filters, *Parasites, Lagoon treatment, Helminth eggs, Filtration, Wastewater lagoons.

In countries with limited water resources, using wastewater for crop irrigation presents an important alternative. However, this can pose risks to both human and animal populations. A study investigated the impact of different wastewater treatments--activated sludge, lagoon treatment, and sand filtration--on helminth eggs. Among the three treatments, lagoon treatment was the most efficient in eliminating helminth eggs, with 100% of the eggs being removed from the effluent from the stabilization basins. The activated sludge and sand filtration treatments reduced the number of eggs by 77.7 and 98.8%, respectively. Most of the eggs were found in the sludge and sediments, with from 160-340 eggs/100 g wet matter. While the lagoon treatment ensures optimal removal of parasites, allowing the eventual reuse of the treated effluent for agricultural purposes, the contaminated sludge poses a problem which this treatment method does not address. Further studies will be necessary to determine the viability and infectivity of these eggs. (Sand-PTT)
W89-12827

WASTEWATER TREATMENT TRENDS IN ALASKA'S COASTAL COMMUNITIES.
Alaska Area Native Health Service, Anchorage.
J. A. Crum.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 7, p 1186-1189, 2 ref.

Descriptors: *Wastewater treatment, *Alaska, *Rural areas, *Wastewater facilities, Sludge disposal, Primary wastewater treatment.

Limited state and federal funding programs in the 1960's resulted in the construction of wastewater collection systems in several coastal communities in Alaska. During the early 1970's, approximately 10 secondary treatment plants were constructed in Alaskan coastal communities by the Indian Health service and the state/EPA construction grants program supported the construction of approximately 10 similar facilities in larger communities. After the Clean Water Act was implemented in 1972, larger cities situated along the coastal states realized that a national policy requiring secondary treatment would be impractical. The 1977 amendments to the Clean Water Act allowed some coastal locations where ocean discharge would not cause environmental damage to discharge wastewater into the ocean. The regulations made it difficult for many villages to qualify because they applied only to existing outfalls and required an exhaustive environmental evaluation and annual testing to show no potential deterioration of the marine environment. Special provisions were established so that coastal villages could address their sanitation, public health, and economic priorities. The revised village program required less data to evaluate the suitability of primary treatment, discharge of only domestic waste, and acceptable collection systems in the communities with new outfalls. Preliminary waiver applications for 77 Alaskan Native communities were made by the Alaska Area Native Health Service (AANHS) in 1978. On-site investigations and mathematical calculations provide the means to evaluate the feasibility of outfalls for ocean disposal of wastewater. Several methods of primary wastewater treatment have been used in Alaskan villages. Recently constructed treatment plants use screening, primary clarifiers, or septic tanks. All primary treatment facilities installed by the AANHS have consisted of community septic tanks. Alaska has two primary wastewater treatment plants that apply only screening. As of 1987, primary treatment was redefined to include settling, and scum removal to achieve 30% BOD and suspended solids removal. Simplified primary wastewater treatment processes allow system operators to spend more time on the operation of their water supplies, water treatment systems, and wastewater collection systems and keep operational costs to a minimum. (Geiger-PTT)
W89-12843

PLANNING FOR WASTEWATER TREATMENT IN SAO PAULO.
HIDROSERVICE - Engenharia de Projectos Ltda., Sao Paulo (Brazil).
J. M. Costa Rodrigues, and E. Pacheco Jordao.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 7, p 1191-1197, July 1989. 1 tab.

Descriptors: *Future planning, *Project planning, *Brazil, *Wastewater treatment, Wastewater facilities, Activated sludge, Dewatering, Primary wastewater treatment, Secondary wastewater treatment.

Completion of the Serra hydroelectric project changed the drainage conditions of Sao Paulo and posed unique sanitation problems for the area. The development of the wastewater treatment system in Sao Paulo was a convoluted process hampered by economic factors, explosive population, growth, and excessive management turnover. Industrial and domestic wastewaters were routed into Billings Reservoir posing poor sanitation as population grew. In 1927, the first interceptor was built in Sao Paulo which is still in operation today. By 1932 the city had its first wastewater treatment plant. Later two other facilities, the Vila Leopoldina and Pinheiros came into operation in 1956 and 1971, respectively. A treatment plant in Suzano City was established in 1976 to convey the metropolitan area's east-zone wastewater flow. The first module of the Barueri treatment plant was commissioned in early 1988. The ABC plant was designed to treat 15 cu m/sec of total flow with five 3-cu m/sec modules. The treatment units featured at each of the above-mentioned treatment plants are tabulated. Most of the plants contain pumping stations, coarse bar racks, fine screens, primary clarifiers, primary sludge degritters, primary sludge thickeners, digestors, and digested sludge dewatering devices. (Geiger-PTT)
W89-12844

LARGE USER'S PERSPECTIVE.
General Motors Corp., Detroit, MI.
R. A. Smith.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 7, p 1198-1205, July 1989.

Descriptors: *Wastewater treatment, *Cost allocation, *Wastewater facilities, *Cost analysis, User costs.

Wastewater rates should maintain the operational and financial stability and health of a treatment facility; be based on the cost-of-service; and avoid any customer cross-class subsidization. The elements that enter into the pricing and availability of wastewater services are of great interest to the large industrial user because service costs directly affect their competitiveness. Cost-based rates help users select resources more efficiently because rates are based on more accurate price signals. Contracts properly design rates and the treatment facility/large user relationship. It is important for wastewater facilities to develop an understanding of large users, their problems, and ways to cope with adverse impacts. The discharger should consider embedded or historical costs as the basis for determining revenue requirements, cost allocation, and rate design; wastewater facility operation as a self-supporting enterprise account, with the benefits of any grants or outside funding shared appropriately by all customers and with revenue subsidies derived from services or sources other than wastewater minimized; rates that track cost-causation patterns of wastewater facility operations, including appropriate cost allocation for effluent discharge loadings and low-level effluent concentrations that reduce treatment plants costs; cost-based rates for all customer classes, avoidance of or, at least, a minimal interclass subsidy; and minimum use of noncost-based rate forms as inverted rates, flat rates, lifeline rates, and marginal cost-based rates. The rate design for the large industrial discharger typically includes a customer charge, a demand-related fixed charge, and a variable or commodity charge. Special contracts, connections, extensions, expansions, and special arrangements, and financing expansion are discussed. (Geiger-PTT)
W89-12845

PERFORMANCE OF A PILOT-SCALE WATER HYACINTH-BASED SECONDARY TREATMENT SYSTEM.
Azurea, Inc., Fort Pierce, FL.
T. A. DeBusk, K. R. Reddy, T. D. Hayes, and B. R. Schwegler.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 7, p 1217-1224, July 1989. 6 fig, 2 tab, 24 ref.

Descriptors: *Wastewater treatment, *Water hyacinth, *Pilot plants, *Biological wastewater treatment, *Retention time, Biochemical oxygen demand, Domestic wastes, Nitrogen removal, Phosphorus removal, Suspended solids, Macrophytes, Sedimentation, Mosquitoes.

A 1-yr study was conducted to evaluate wastewater treatment performance of four water hyacinth raceways (0.1 ha each) that received primary domestic effluent at hydraulic retention times (HRT) of 3, 6, 12, and 24 days. A raceway operated at a relatively short HRT (6 days) provided high rates of BOD5 and suspended removal but low rates of N and P removal. Reductions in fecal coliform concentrations at this same HRT averaged only one order of magnitude. Removal rates (mass per unit area basis) for BOD5, suspended solids, nitrogen and phosphorus decreased with increasing HRT, whereas percentage removal rates increased and effluent constituent concentrations decreased with increasing HRT. Microcosm studies using water hyacinth systems operated at a 6-day HRT demonstrated that BOD5 and suspended removal are not influenced by plant harvest regime. Plant harvest regime also had little affect on sedimentation. The water hyacinth raceways did not produce objectionable odors, but they did provide a suitable environment for mosquito development. (Author's abstract)
W89-12846

AMMONIA REMOVAL USING OVERLAND FLOW.
J. Zirschky, D. Crawford, L. Norton, S. Richards, and D. Deemer.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 7, p 1225-1232, July 1989. 1 fig, 11 tab, 11 ref.

Descriptors: *Wastewater treatment, *Ammonia, *Nitrogen removal, *Overland flow, Surface runoff, Pilot plants, Monitoring.

The Duck Creek Wastewater Treatment Plant, Garland, Texas, implemented a program of overland flow to reduce the level of ammonia in advanced secondary effluent. Five overland flow terraces were constructed, three measuring 140 m wide and 91 m from top to bottom of the slope (terraces A, B, and C). The remaining two were the same length, but 70 m wide (terraces D and E). Applications on terraces A, B, and C were conducted by full-circle impact sprinklers. Terrace D used low pressure fan nozzles, and Terrace E used gated pipe. Various application rates were tried on each slope. Monitoring for ammonia, BOD, and suspended solids was conducted on samples taken from the applied wastewater, the runoff down the terraces, and the effluent from each terrace. Overland flow was found very effective in removing ammonia from advanced secondary effluent. At application rates up to 0.43 cu m/m-hr and terrace lengths of 60 m, ammonia-nitrogen removal efficiencies of greater than 97% were achieved. Application devices did not affect treatment performance, although sprinklers provided better treatment for higher application rates or shorter terraces. (Geiger-PTT)
W89-12847

PEAK SEWAGE FLOW RATE: PREDICTION AND PROBABILITY.
Denver Wastewater Management Div., CO.
J. B. Gaines.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 7, p 1241-1248, July 1989. 6 fig, 6 tab, 8 ref.

Descriptors: *Wastewater treatment, *Mathematical models, *Theoretical analysis, *Flow rates, Flow measurement, Regression analysis.

The source of peak flow factor criteria for sewers in Denver, Colorado, was investigated and its origin traced with some observations regarding its derivation and relationship to reality. A series of equations for predicting observed reality at different intervals were developed using linear regression analysis. Identical analyses were performed on the weighted data using the Statistical Package for the Social Sciences program to determine the instantaneous peak, maximum 1-hr, maximum 6-hr and minimum 1-hr flow factors in units of liters/sec, cfs, and mgd. There was, in general, a considerable difference between the derived flow factors and those calculated using the original equations. The proper way to calculate future sewer flow rates is to multiply the expected average flow rate times an appropriate peaking factor then add the anticipated ratio of infiltration to inflow. Factors of probability and risk in the design of the sanitary sewer should also be considered. (Geiger-PTT)
W89-12849

ELIMINATION OF SULPHUR COMPOUNDS FROM WASTEWATER BY THE ROOT ZONE PROCESS: I. PERFORMANCE OF A LARGE-SCALE PURIFICATION PLANT AT A TEXTILE FINISHING INDUSTRY.
Gesamthochschule Kassel (Germany, F.R.). Dept. of Ecochemistry.
M. Winter, and R. Kickuth.
Water Research WATRAG, Vol. 23, No. 5, p 535-546, May 1989. 10 fig, 8 tab, 45 ref.

Descriptors: *Wastewater treatment, *Textile mill wastes, *Sulfur, *Biological wastewater treatment, *Nutrient removal, *Root zone, Sulfates, Sulfur compounds, Marsh plants, Wetlands, Rhizosphere.

The Root Zone methods removes sulfur from wastewater by sending effluent through a sealed bed of soil planted with helophytes. Operational experiences in the purification of textile finishing effluent on beds of Phragmites communis Trin. using the Root Zone system are considered. In a 0.44 ha section of a Root Zone plant of 19 ha on average 76% of COD and 82% of total-sulfur load, equivalent to 27 t O2/ha/yr and 3.5 t sulfur/ha/yr, respectively, were removed from the wastewater. Despite a lack of nutritive salts in the effluent there has so far been no need to use fertilizers to support the process. The Root Zone system can adapt to a different effluent quality in 1-3 wk. Over the 12-yr operational period there have been no breakdowns in purification performance despite loading with a broad and often changing variety of industrial chemicals. (Author's abstract)
W89-12858

ELIMINATION OF SULPHUR COMPOUNDS FROM WASTEWATER BY THE ROOT ZONE PROCESS: II. MODE OF FORMATION OF SULPHUR DEPOSITS.
Gesamthochschule Kassel (Germany, F.R.). Dept. of Ecochemistry.
M. Winter, and R. Kickuth.
Water Research WATRAG, Vol. 23, No. 5, p 547-560, May 1989. 8 fig, 14 tab, 26 ref.

Descriptors: *Sulfur, *Nutrient removal, *Biological wastewater treatment, *Wastewater treatment, *Root zone, *Fate of pollutants, Sulfur compounds, Sulfates, Path of pollutants, Leaching, Rhizosphere, Volatilization, Marsh plants.

In a 0.44 ha technical Root Zone plant, which was 8 yr old, 82% of sulfur brought in with the effluent was eliminated. For proving the solidity of the Root Zone method for wastewater treatment, it is important to know whether the sulfur compounds are shifted outside the system thus causing harm, or whether they remain inside the Root Zone in any stable form. Chemical analysis of the various compartments within and outside the ecosystem, e.g. water, air, soil, plant, allowed a balancing of sulfur compounds. Results indicated that only small amounts of sulfur could have been volatilized

into the atmosphere or leached vertically into the drainage. Only 1% of inflowing sulfur was absorbed by the plant shoots. A large amount of sulfur compounds was found as a deposit in the soil of the Root Zone system. Sulfur compound deficits in the outlet are more or less accounted for by the sulfur deposits. Thiosulfate is converted to elemental sulfur which is deposited in the soil at a rate of 1.3 t S/ha/yr or 31% of inflowing S quantity. Thiosulfate is converted to organic sulfur in the form of humic S, e.g. sulfur ester, and accumulated at a rate of 1.0 t S/ha/yr or 25% of inflowing S quantity. S and organic S are stable, long-term deposit forms. Sulfide and sulfate, which are short-term deposit forms, represent only a small percentage of S deposits in the soil. Biological conversions in the aerobic/anaerobic mosaic structure of the soil as well as soil chemical reactions take part in these sulfur conversions in the Root Zone process. The Root Zone method features intensive humus formation which fixes carbon, sulfur and nitrogen compounds and counteracts the anthropogenic production of COx, SO2 and NOx in the atmosphere. (Author's abstract)
W89-12859

COMPARISON OF THE BIOSORPTION AND DESORPTION OF HAZARDOUS ORGANIC POLLUTANTS BY LIVE AND DEAD BIOMASS.
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W89-12860

SLAUGHTERHOUSE EFFLUENT TREATMENT BY THERMOPHILIC AEROBIC PROCESS.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard, S. Gariepy, and F. T. Tran.
Water Research WATRAG, Vol. 23, No. 5, p 573-579, May 1989. 4 fig, 3 tab, 44 ref. NSERC Grant No. A-3711. FCAR 87 Grant No. As-246.

Descriptors: *Biological wastewater treatment, *Food-processing wastes, *Wastewater treatment, *Phosphates, Activated sludge, Aerobic bacteria, Mathematical models, Kinetics, Growth rates, Respiration.

A pig slaughterhouse effluent was submitted to laboratory runs in order to assess the potentiality of the thermophilic aerobic process for the treatment of meat processing industry's effluents. A mixed aerobic bacterial culture was successfully maintained at 52 and 58 degrees in a semi-continuously fed bioreactor, without recycling the cells. Operation was conducted at 6, 12, 18, 24, and 30 hr of solids retention time. Over 93% of the chemical oxygen demands (CODs) were removed during the treatment at 52 degrees for all the retention times investigated, as compared to 86% of removal at 58 degrees, with an exception for the case of 6 hr retention time. Reduction of phosphorus in the form of orthophosphate ranged between 72-90% with the best efficiency noted at 52 degrees and 6 hr retention time. Extremely high specific utilization rates were observed and revealed that the process is about 10 times faster than the mesophilic process for slaughterhouse effluent treatment. Biokinetic parameters of maximal specific growth rate and endogenous respiration coefficient (kd) were evaluated by fitting to appropriate mathematical models. They were found superior to those reported in the literature for the mesophilic process, with the exception of the Y (actual yield) coefficient which is of the same magnitude. High kd values had a marked effect on the apparent yield of sludges which showed low values as compared to those found in mesophilic systems. (Author's abstract)
W89-12862

THEORETICAL ANALYSIS OF BACKWASH TIME IN RAPID SAND FILTERS.
Roorkee Univ. (India). Dept. of Civil Engineering.
D. S. Bhargava, and C. S. P. Ojha.
Water Research WATRAG, Vol. 23, No. 5, p 581-587, May 1989. 5 fig, 4 tab, 3 ref.

Descriptors: *Sand filters, *Filtration, *Turbidity, *Mathematical models, *Wastewater treatment, *Water treatment, Theoretical analysis, Separation techniques.

A theoretical analysis of the backwash time and the prediction of the total turbidity emerging during a backwash operation was made using a mathematical model for rapid sand filters. The models presented can be used for an advance prediction of the variation of the total backwash water turbidity with respect to the duration of the backwash time. To verify the predicted turbidity variations during backwashing operation, experimental observations were made during the backwashing of a rapid sand filter at the water works of Dehradun, U.P. India. A fairly good agreement was found between the theoretically predicted and the experimentally observed values of the turbidity variations in the backwash water. The presented models can be exploited for the management of filter backwashing operations. The models could also be useful in the design of the washwater troughs due to an advance prediction of the total maximum turbidity load that the troughs are supposed to handle. (Geiger-PTT)
W89-12863

GAS- AND LIQUID-PHASE MASS TRANSFER RESISTANCES OF ORGANIC COMPOUNDS DURING MECHANICAL SURFACE AERATION.
Stanford Univ., CA. Dept. of Civil Engineering.
C. Munz, and P. V. Roberts.
Water Research WATRAG, Vol. 23, No. 5, p 589-601, May 1989. 9 fig, 5 tab, 64 ref, append. U.S. EPA Grant R-806631.

Descriptors: *Aeration, *Organic compounds, *Activated sludge process, *Wastewater treatment, *Water treatment, Mass transfer, Oxygen, Biological wastewater treatment, Resistance.

The mass transfer behavior of a suite of six volatile halogenated organic compounds and oxygen was investigated in a laboratory scale reactor representative of mechanical surface aeration during activated sludge treatment. The rate of mass transfer of the organics was related to that of oxygen by a proportionality factor. Significant deviations were observed for the least volatile solute from the expected constant value of the proportionality factor under the assumption of liquid phase controlled mass transfer. Data analysis and interpretation according to two-resistance mass transfer models with appropriate correction for the slight variation in molecular diffusivities indicates that the gas phase resistance to mass transfer is more important than previously assumed. Based on this work and on the data analysis of two other studies it is recommended that a value for the ratio of the individual phase mass transfer coefficient of the gas to the liquid phase of approximately 40 be used to estimate the relative importance of gas and liquid phase mass transfer resistances in mechanical surface aeration under conditions of high specific power input. Consequently, only compounds with a dimensionless Henry's constant of $>$ or $=$ 0.55 can be considered to exhibit complete liquid phase controlled mass transfer behavior. It appears that the liquid phase mass transfer rate constant is proportional to the square root of the diffusivity in accordance with the penetration and surface renewal theories. The dissolved constituents present in treated wastewater reduce the rate of mass transfer of organic solutes and oxygen in a proportional fashion. Since the conditions of operation and the observed rates of oxygen mass transfer in this work are similar to those encountered in the field, there is reason to believe that these findings are also valid under conditions typical of water and wastewater treatment. (Author's abstract)
W89-12864

HEAVY METAL REMOVAL IN ATTACHED-GROWTH WASTE STABILIZATION PONDS.
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environamental Engineering.
C. Polprasert, and K. Charnpratheep.
Water Research WATRAG, Vol. 23, No. 5, p 625-631, May 1989. 3 fig, 3 tab, 17 ref.

Descriptors: *Wastewater treatment, *Heavy metals, *Stabilization ponds, *Cadmium, *Chromium, Pilot plants, Adsorption, Separation techniques, Mathematical models.

Experiments on attached-growth waste stabilization ponds (AGWSP) were conducted to investigate the performance of AGWSP units that received Cd and Cr shock loadings. Under the experimental conditions employed, the laboratory-scale and pilot-scale AGWSP units had less concentrations of the applied heavy metals present in the effluents than those in the effluents of the waste stabilization pond (WSP) units without attached-growth media. The superior performance of the AGWSP units was due to adsorption of the applied heavy metals on the attached-growth media. An empirical model was developed which could satisfactorily predict heavy metal concentrations in the AGWSP and WSP effluents after heavy metal shock loadings. (Author's abstract)
W89-12867

KINETIC MODEL FOR IDEAL PLUG-FLOW REACTORS.
Technical Univ. of Istanbul (Turkey). Dept. of Environmental Engineering.
H. A. San.
Water Research WATRAG, Vol. 23, No. 5, p 647-654, May 1989. 2 fig, 4 tab, 19 ref.

Descriptors: *Model studies, *Plug flow, *Biomass, *Activated sludge process, *Mathematical models, *Wastewater treatment, Finite difference methods, Differential equations.

Simultaneous differential equations of plug-flow reactors resulting from mass balances on substrate and biomass around an infinitesimal volume element were solved analytically taking the longitudinal biomass gradient into account under steady-state conditions. A relationship between substrate and biomass concentrations and an analytical solution for substrate and/or biomass concentration as a function of hydraulic residence time was developed. Design examples indicated that results of analytical solutions were in good agreement with those of differential equations obtained by the finite difference method. A numerical method for determination of mean solids residence time was developed. It was found that kinetic coefficients have pronounced effects upon mean solids residence times, suggesting that more realistic studies reflecting field conditions are required for determination of kinetic coefficients and for evaluation of treatability experiments. (Geiger-PTT)
W89-12869

EVALUATION OF MANUFACTURED INOCULA FOR USE IN THE BOD TEST.
Trinity Coll., Dublin (Ireland). Environmental Sciences Unit.
For primary bibliographic entry see Field 5A.
W89-12870

CHARACTERISTICS OF DEPOSITS IN COMBINED SEWERS: CONSEQUENCES ON THEIR TRANSPORT (JCARACTERISTIQUES DES DEPOTS EN RESEAU D'ASSAINISSEMENT UNITAIRE: CONSEQUENCES SUR LEUR TRANSPORT).
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
O. Artieres, and G. Stotz.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 243-246, 1989. 5 fig, 2 tab, 9 ref. English summary.

Descriptors: *Sewer hydraulics, *Combined sewers, *Sewer systems, *Sediment transport, Organic matter, Sand, Organic wastes, Domestic wastes, Silt, Cohesion, Erosion, Model studies.

Deposits in combined sewers are composed of sand particles from the streets and organic domestic waste. Despite its small amount, this organic matter has a big influence on the deposit transport. It produces, with the smaller silt particles, a cohesive mixture that binds the sand particles among

themselves and increases their erosion resistance. Many additional parameters complicate the study of its transport and its modeling of these deposits. (Author's abstract)
W89-12888

WATER QUALITY MANAGEMENT IN THE RUHR AREA.
Ruhrverband, Essen (Germany, F.R.).
K. R. Imhoff.
Regulated Rivers Research and Management RRRMEP, Vol. 4, No. 2, p 119-128, July 8, 1989. 6 fig, 2 tab, 22 ref.

Descriptors: *Ruhr River, *West Germany, *Water supply development, *Water quality management, *Water pollution control, Multireservoir networks, Flow augmentation, Nonpoint pollution sources, Wastewater facilities, Activated sludge process, Storm water, Tertiary wastewater treatment, Wastewater lagoons, Biological wastewater treatment, Nutrient removal, Chemical precipitation, Municipal wastewater, Phosphorus, Nitrogen, Eutrophication, Heavy metals.

The Ruhr River is the major source of water supply for the North Rhine-Westphalian industrial district. To ensure drinking water supply from the river a system of reservoirs has been constructed for low flow augmentation. Five additional river impoundments have been built for the abatement of nonpoint pollution. The Ruhr River Association was established in 1913. Its first task was the reduction of coarse pollution by mechanical treatment plants. Activated sludge plants were introduced as early as 1926. Developments continued and presently tertiary treatment is performed by polishing lagoons on one-third of the Ruhrverband plants and a program of storage and subsequent biological treatment of stormwater is underway. One important future task is nutrient removal from municipal wastewater by chemical precipitation and biological processes. Phosphorus concentrations in river water have to be diminished to fight eutrophication while nitrogen must be reduced because of drinking water considerations. Heavy metals have to be further controlled and organically attached halogens have to be diminished. (Author's abstract)
W89-12911

EXPERIMENTAL AND THEORETICAL STUDIES OF SULFIDE GENERATION IN SEWERAGE SYSTEMS.
Monash Univ., Clayton (Australia). Dept. of Chemical Engineering.
G. A. Holder, R. VanOorschot, and J. Hauser.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 757-768, 1989. 4 fig, 3 tab, 20 ref.

Descriptors: *Sewer systems, *Sulfides, *Industrial wastes, Waste disposal, Rotating drum reactor, Theoretical analysis, Slime, Sanitary engineering.

The measurement of sulfide generation rates from sewer slimes using a rotating-drum reactor is described. The practical utility of this procedure for assessing the contribution to sulfide production which arises from the admission of industrial wastes into domestic sewage is demonstrated. The use of the reactor for more theoretical purposes, such as the determination of the zero-order constant for a particular sewage, is also considered. The effect of flow velocity on sulfide generation was investigated by pumping sewage at controlled rates through a 'model' sewer which 'flowed full'. Under turbulent flow conditions, the rate of sulfide production (expressed as a mass flux g/sq m/day) was relatively high and the effect of flow rate on the rate of production was positive but small. In the laminar region, the situation was reversed; the sulfide flux was relatively large. Theoretical studies of sulfide generation are outlined. The zero order constant, determined using the rotating drum reactor, was utilized to predict sulfide generation rates in the model sewer. Agreement between experiment and prediction was satisfactory for conditions of turbulent flow. For laminar flow, the agreement was less satisfactory. However, the predictions for laminar flow were qualitatively correct in as much that a significant drop in sulfide generation was observed on moving into the laminar flow region. The results show that it is possible to develop a predictive design procedure for sulfide production based in established engineering principles rather than relying on empirical correlations. (Author's abstract)
W89-13053

SUBSTRATE AFFINITY OF OLIGOTROPHIC BACTERIA IN BIOFILM REACTORS.
Kurita Water Industries Ltd., Atsugi (Japan).
K. Nakamura, M. Shibata, and Y. Miyaji.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 779-790, 1989. 8 fig, 6 tab, 12 ref.

Descriptors: *Biofilms, *Wastewater treatment, *Biological wastewater treatment, *Bacteria, *Oligotrophy, Biofilm reactors, Substrates, Oligotrophic bacteria, Pseudomonas.

Several biofilm reactors were operated to investigate the substrate affinity of oligotrophic bacteria in the biofilm reactor. The attached oligotrophs were removed from reactors, and substrate affinity was determined in dispersed form. The saturation constant (Ks) of attached oligotrophs for acetate was less than 10 microg C/l. The apparent Ks (Ksa) values of the reactors were also determined to evaluate the performance of reactors, and the effect of specific surface area of packed media on KSa was investigated at a loading of 0.006 mg C per cu cm apparent media volume per hour. Larger specific surface area led to smaller Ksa and 6.9 microg C/l of Ksa for acetate was obtained with the media having 340 sq cm surface area per cu cm apparent media volume of specific surface area. The bacterial flora in the oligotrophic biofilm was examined, and Pseudomonas was found to be dominant. (Author's abstract)
W89-13055

MODELLING OF THE SIMULTANEOUS REMOVAL OF ORGANIC SUBSTANCES AND NITROGEN IN A BIOFILM.
Zhejiang Agricultural Univ., Hangzhou (China). Dept. of Environmental Protection.
G. H. Chen, H. Ozaki, and Y. Terashima.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 791-804, 1989. 12 fig, 5 tab, 20 ref.

Descriptors: *Oxidation, *Nitrification, *Denitrification, *Mass transfer, *Biofilms, *Wastewater treatment, *Biological wastewater treatment, *Organic compounds, *Nitrogen, *Model studies, *Mathematical models, Mass balance equations, Biofilm reactors, Nitrogen removal, Dissolved oxygen, Ammonium, Alkalinity.

A mathematical model of the simultaneous removal of organic substances and nitrogen compounds in a biofilm reactor was developed, taking into account the relationships between oxidation, nitrification, denitrification, and mass transport. The model consists of a set of simultaneous mass balance equations for organic substances, ammonium nitrogen, oxidized nitrogen, oxygen, and alkalinity within the biofilm, and another set of transport equations for these substances within diffusion layer of the biofilm. Synthetic dual and triple Monod-type kinetics describing, respectively, oxidation and nitrification/denitrification were incorporated into the mass balance equations. The model was evaluated based on experimental data and the computer simulations. This model successfully explained the mechanism of simultaneous removal and the effects of bulk concentrations of organic substances, dissolved oxygen, ammonium nitrogen, and alkalinity on simultaneous removal in a submerged biofilm reactor. (Author's abstract)
W89-13056

BIOFILM STRUCTURE - AN IMPORTANT AND NEGLECTED PARAMETER IN WASTEWATER TREATMENT.
Technical Univ. of Denmark, Lyngby. Dept. of Biochemistry and Nutrition.
F. R. Christensen, G. H. Kristensen, and J. L. Jansen.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 805-814, 1989. 10 fig, 14 ref.

Descriptors: *Biofilms, *Wastewater treatment, *Biological wastewater treatment, Kinetics, Experimental data, Biofilm reactors, Model studies, Substrates.

Experimental investigations on the kinetics of wastewater treatment processes in biofilms were performed in a laboratory reactor. Parallel with the kinetic experiments, the influence of the biofilm kinetics on the biofilm structure was studied at macroscopic and microscopic levels. The close interrelationship between biofilm kinetics and structural changes caused by the kinetics is illustrated by several examples. It is evident that the traditional modeling of wastewater treatment processes in biofilm reactors based on substrate removal kinetics alone will fail in many cases, due to the inevitable changes in the biofilm structure not taken into consideration. Therefore, design rules for substrate removal in biofilms used for wastewater treatment must include correlations between removal kinetics and the structure and development of the biological film. (Author's abstract)
W89-13057

DEGRADATION OF POLYELECTROLYTES IN THE ENVIRONMENT: INSIGHTS PROVIDED BY SIZE EXCLUSION CHROMATOGRAPHY MEASUREMENTS.
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
T. Soponkanaporn, and R. Gehr.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 857-868, 1989. 14 fig, 1 tab, 25 ref.

Descriptors: *Polyelectrolytes, *Water treatment, *Separation techniques, *Water pollution sources, *Wastewater treatment, *Degradation, *Chromatography, Size exclusion chromatography, Aging, Ozonation, Chlorination, Biodegradation, Hydrogen ion concentration, Water pollution sources.

Using a recently developed method for analyzing high molecular weight polyelectrolytes by size exclusion chromatography (SEC), the degradation due to ageing, ozone, chlorine, and biological processes, of a commercially available cationic polyelectrolyte, was investigated. These polyelectrolytes are widely used in water and wastewater treatment, and residuals discharged into drinking water or into natural water bodies could be subjected to one or more of the above-mentioned degradation processes. In general, degradation rate increased with decreasing concentration, increasing pH, and increasing temperature. SEC measurements showed that complete degradation (to CO2 and other inorganic monomers) occurred only during biodegradation. Ozonation and chlorination increased degradation rates, but also produced refractory compounds. Acrylamide, one of the starting monomers of the copolymers used, was not produced during degradation, and in fact decreased in concentration during all the degradation mechanisms studied. On the other hand, chloroform was produced as a result of interaction with chlorine. At pH 9, the mass produced, 58 microg/mg polyelectrolyte, could result in substandard drinking waters if significant residual concentrations of this polyelectrolyte were chlorinated. (Author's abstract)
W89-13062

BACILLUS SUBTILIS/MICROSOME RECASSAY FOR THE DETECTION OF DNA DAMAGING SUBSTANCES WHICH MAY OCCUR IN CHLORINATED AND OZONATED WATERS.
Kyoto Univ., Otsu (Japan). Lab. for Control of Environmental Micropollutants.
For primary bibliographic entry see Field 5A.
W89-13064

POLYMER CHARACTERISTICS AND ATTACHMENT SITES IN THE SLUDGE MATRIX.
Hydrologic, Inc., Stillwater, OK.
U. N. Tyagi, and P. T. Bowen.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 899-908, 1989. 8 fig, 1 tab, 16 ref.

Descriptors: *Sludge conditioning, *Wastewater treatment, *Sludge, *Polymers, Anions, Cations, Ferritin, Electron microscopy.

Polymer attachment sites in three types of sludge were identified for different molecular weight and charge density cationic polymers. Conditioned and unconditioned sludge samples were treated with cationized ferritin (CF) to label anionic charged sites on the surface of sludge particles. Sludge surfaces were examined using transmission electron microscopy. The presence of CF indicates an anionic site not attached to polymers. For increasing polymer molecular weight, comparison of micrographs of samples conditioned with similar polymer doses showed an increase in CF attachment. Therefore, polymer attachment was seen to decrease with increasing polymer molecular weight. At extremely high polymer dosages, the presence of CF indicates that anionic sites have not been saturated by polymers. These results imply the molecular weight (chain length) and structure of polymers may determine the mechanisms of polymer action. No appreciable differences were observed for sludges conditioned with polymers of various charge densities. (Author's abstract)
W89-13066

EFFECTS OF VARIOUS SEWAGE SLUDGE TREATMENT PROCESSES ON THE SURVIVAL OF POTATO CYST-NEMATODES (GLOBODERA SPP.) AND THE IMPLICATIONS FOR DISPOSAL.
Edinburgh School of Agriculture (Scotland).
A. M. Spaull, D. M. McCormack, and E. B. Pike.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 909-916, 1989. 8 tab, 10 ref.

Descriptors: *Sludge disposal, *Land disposal, *Sludge utilization, *Wastewater treatment, *Waste disposal, *Sludge, *Potatoes, *Nematodes, Cysts, Survival, Scotland.

Samples of sewage sludges, taken over a twelve-month period from nine Scottish sewage works, contained an average of 0.24 cysts of Globodera spp. (potato cyst-nematodes) of which 11% were viable. The incidence was not significantly related to season or to the presence of vegetable-processing effluent. Exposure of cysts in sludge to mesophilic anaerobic digestion (35 C, 30 min), cold anaerobic digestion (9 weeks), pastuerization (70 C. 30 min) and aerobic thermophilic digestion (60 C, 1 d) reduced viability of eggs within the cysts by almost 100%. Sludges so treated can, therefore, be considered to be free from infection risk to potato crops, although the non-infective cysts may still be recovered. treatment with lime at pH 11.5 (20 C, 24 h), by aerobic stabilization in an oxidation ditch (7 weeks) and by activated-sludge treatment (5 d) did not reduce viability acceptably. Accelerated cold digestion did not reduce viability sufficiently after the usual 15 weeks but rendered eggs completely non-viable after 21 weeks. The results show that even sludge treated to destroy viable cysts should not be applied to land use for growing seed potatoes and subject to testing for freedom from infestation. Treatment destroying viability should increase the acceptability of sludge for ware potato growers, although the numbers of cysts applied in untreated sludge would be unlikely to significantly increase levels of cysts in already-infested soils. (Author's abstract)
W89-13067

RELATION BETWEEN REDOX POTENTIAL AND OXYGEN LEVELS IN ACTIVATED-SLUDGE REACTORS.
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Paris (France).
A. Heduit, and D. R. Thevenot.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 947-956, 1989. 10 fig, 1 tab, 15 ref.

Descriptors: *Wastewater reactors, *Wastewater treatment, *Activated sludge, *Dissolved oxygen, *Oxidation-reduction potential, Platinum electrode potential, Current-potential curves, Biochemical oxygen demand, Aeration, Hydrogen ion concentration, Mixed liquor solids, Volatile solids, Plug flow, Septic sludge, Aerators, Chemical reactions.

The importance of dissolved oxygen level in determining the platinum electrode potential in activated sludge has been clearly demonstrated by current-potential curves plotted at different oxygen concentrations. Tests have been carried out, in the laboratory and in full-scale treatment plants, to define the relationship between the platinum electrode potential at equilibrium (Eh) and the dissolved oxygen concentration in activated sludge. These two parameters obey a law of the form Eh = a + b log (dissolved oxygen concentration). The measured values of coefficients a and b differ widely from those found from the oxygen reduction reaction in water (a = 0.8 V at pH 7 and b = 15 mV per decade). Factors a and b mainly depend on the sludge loading, the aeration conditions and the sludge concentration. Using non-polished stationary platinum ring electrodes, the following values of a were obtained (at pH between 7 and 7.6): (1) +410 mV/NHE (normal hydrogen electrode) for sludge aerated for several hours without feeding, (2) +265 mV/NHE for over-aerated/low-loaded sludge (Cm (sludge loading) = 0.2 BOD kg/MLVSS (mixed liquor volatile suspended solids)/day), and (3) +180 mV/NHE for high loaded activated sludge in plug-flow system (Cm = 1 kg BOD kg/MLVSS/day). Factor b would seem to lie between 55 and 65 mV when the sludge is continuously aerated without feeding. At low loads with excess aeration, it lies between 70 and 90 mV. When the medium is slightly septic at low dissolved oxygen concentrations (insufficient daily aeration time, high sludge concentration or aerators shut down for too long periods). Factor b increases and can reach 200 mV. In the same way, at high loads, factor b can become 150 mV. These results demonstrate the importance of dissolved oxygen concentration in the mechanisms which determine the metal electrode potentials in activated sludge. (Author's abstract)
W89-13071

DETERMINATION OF BIODEGRADATION KINETICS THROUGH USE OF ELECTROLYTIC RESPIROMETRY.
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 5B.
W89-13072

OPTIMIZATION STUDY OF THE PLANNING OF WATER POLLUTION CONTROL FOR MAJIAGOU STREAM IN HARBIN, CHINA.
Harbin Architectural and Civil Engineering Inst. (China). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5E.
W89-13075

DEVELOPMENT OF OPERATOR TRAINING IN THE REPUBLIC OF SOUTH AFRICA.
Department of Water Affairs, Pretoria (South Africa).
R. H. Cormack, N. J. Lewis, and J. J. Barnard.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 1025-1035, 1989. 13 ref, append.

Descriptors: *Personnel, *Wastewater treatment, *Water treatment, *South Africa, *Training, Drinking water, Effluents, Education, Future planning, Classification, Administrative agencies, Safety.

As part of the campaign to protect the Republic of South Africa's limited water resources, legislation has been drawn up stipulating the number and calibre of operators to be employed on a water care works. The registration and classification of both works and their operators will provide essential information for the refining and expansion of present training provisions. Four new courses in water and wastewater treatment have been approved for inclusion in the National Technical Certificate system. A preliminary strategy is outlined and some anticipated improvements and modifications to be made in the years ahead are given. The registration and classification undertaking is a control measure to protect the water resources of South Africa. It will enable the Department of Water Affairs to quantify the shortage of skilled operators ad therefore to plan accordingly. The aim is for each of the works to have adequate numbers of suitably trained personnel to consistently produce safe drinking water or acceptable effluents. (Miller-PTT)
W89-13078

QUANTIFICATION OF COENZYME F420 ANALOGUES FROM METHANOGENIC BACTERIA BY HPLC AND FLUORIMETRY.
Katholieke Univ. Nijmegen (Netherlands). Dept. of Microbiology.
L. G. M. Gorris, A. K. Kivaisi, and H. J. M. Op den Camp.
Biotechnology Techniques BTECE6, Vol. 3, No. 4, p 239-244, July/August 1989. 3 fig, 1 tab, 20 ref.

Descriptors: *Wastewater treatment, *Water analysis, *Wastewater analysis, *Digested sludge, *Coenzymes, *Methane bacteria, Liquid chromatography, Wastewater facilities, Analytical methods.

The concentration of coenzyme F420 in pure cultures or digested sludges has been correlated with methanogenic activity. Various assays have been used since 1979 to quantify F420. Van Beelen and associates introduced a fluorometric assay that included separation of coenzyme F420 from interfering substances by reversed-phase high performance liquid chromatography (HPLC). Based on this assay, HPLC-based assays employing isocratic or gradient elution of cofactors were developed. An improved HPLC-based assay is described here that makes possible the selective detection of various coenzyme F420 analogues with high resolution at short run times. Application of the assay is illustrated with sludge from three upflow anaerobic sludge blanket (UASB) digestors. Quantification with a coenzyme F420 standard. The suitability of coenzyme F420 fragments as internal standards was investigated as well. Fragment FO has the disadvantage that it may occur already in the sample being analyzed. F+ and 8-hydroxy-10-methyl-5-deazaisoalloxazine (8-HMDI) are possible alternatives. At higher concentrations F+ overlaps FO, so that if FO is present, detection could be a problem. 8-HMDI, in contrast, elutes after FO and does not interfere with its detection, even when added in large quantities. (Rochester-PTT)
W89-13110

POLLUTED WATER RENOVATION FOR REUSE: RECENT BIOTECHNOLOGICAL ADVANCES APPLICABLE IN HOT ARID REGIONS.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. of Aquatic Sciences.
G. Hamer, T. Egli, and N. Al-Awadhi.
Desalination DSLNAH, Vol. 72, No. 1/2, p 31-65, Apr/May 1989. 69 ref.

Descriptors: *Wastewater renovation, *Arid lands, *Biological wastewater treatment, *Wastewater disposal, *Water reuse, *Microbial degradation, Sludge seeding, Industrial wastewater, Arid zone, Temperature effects, Cultivated lands, Pathogens.

Both sewage and industrial wastewater are important resources in hot arid regions provided they can be economically purified to meet the requirements of reuse. Conventional treatment technology involves a sequence of physical, biological and physico-chemical process steps designed for effective pollutant removal in temperate climates where, even there, overall process performance is rarely optimal. Frequently, the reason for this is that the process microbiology involved in biotreatment is little understood and very largely ignored in spite of the fact that it is the biotreatment step that is responsible for the removal of the bulk pollutant load. There have been recent advances in process microbiology that will permit more effective biotreater operation at high ambient temperatures and the way in which these advances can be incorporated into the design of biotreatment processes for the effective and economic purification of sewage and industrial wastewater, so as to allow their sensible reuse, and of waste sludge, so as to allow safe disposal on cultivated land. Emphasis is placed particularly on elimination of noxious

chemical pollutants and pathogenic organisms during biotreatment. (Author's abstract)
W89-13140

HEALTH CONSIDERATIONS IN USING TREATED INDUSTRIAL AND MUNICIPAL EFFLUENTS FOR IRRIGATION.
Ministry of Public Health, Safat (Kuwait). Environment Protection Dept.
For primary bibliographic entry see Field 3C.
W89-13142

TOWARDS THE USE OF INDUSTRIAL WASTEWATER FOR IRRIGATION IN KUWAIT.
College of Technological Studies, Shuwaikh (Kuwait).
For primary bibliographic entry see Field 3C.
W89-13143

POSSIBILITIES OF UTILIZING MUNICIPAL AND INDUSTRIAL WASTEWATER EFFLUENTS TO CONDITION SOIL.
Kuwait Inst. for Scientific Research, Safat.
K. Puskas, and I. Esen.
Desalination DSLNAH, Vol. 72, No. 1/2, p 125-132, Apr/May 1989. 6 fig, 1 tab.

Descriptors: *Soil amendments, *Water resources development, *Wastewater renovation, *Water reuse, *Industrial wastewater, *Municipal wastewater, *Wastewater treatment, *Arid-zone hydrology, Treated water, Pilot plants, Algae, Water depth, Fertilizers, Sand filters, Organic loading, Coliforms, Flow rates, Chemical oxygen demand, Detention time, Suspended solids, Crop yield, Ponds, Kuwait.

Arid zones need to maintain and restore water resources. Therefore, the ability to utilize municipal and industrial wastewater effluents is of special importance to Kuwait. The treated water can be reused, and the valuable components in the wastewater and the byproducts of the treatment process can be beneficially utilized. A pilot plant integrated ponding system was constructed with the basic objectives of treating municipal wastewater and producing reusable algae. Raw sewage was allowed to pass through an oil and sand trap and then enter directly into facultative ponds in which organic loading was considerably reduced by mostly anaerobic processes. The effluent from the facultative ponds was then introduced into high rate ponds where high concentrations of photosynthetic algae were produced, and further removal of organic matter and coliform bacteria took place. The algae was finally removed by sand filtration. The pilot plant basically consists of two facultative ponds each having a surface area of 100 square meters and two high rate ponds each having a surface area of 44 square meters. The depth of the water in the ponds can be varied. Several experiments were made with different depths of flow and detention times. Removal of biochemical oxygen demand, chemical oxygen demand, suspended solids, nutrients and coliform bacteria; and, soil conditioning and fertilizer effect of the algae produced were investigated. Results obtained indicate a significant reduction in pollution concentrations. Preliminary investigations showed that irrigation with the pilot plant effluent increased crop yield. (Author's abstract)
W89-13144

SOME APPROACHES TO SETTING CLEANUP GOALS AT HAZARDOUS WASTE SITES.
For primary bibliographic entry see Field 5G.
W89-13201

OZONATION.
Brown, Boveri Research Center, Baden (Switzerland).
S. Stucki.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 513-529, 1 tab, 13 fig, 37 ref.

Descriptors: *Water treatment, *Disinfection, *Ozonation, Chemical properties, Biocides, Pretreatment of water, Fouling, Contamination, Microorganisms, Ozone, Redox potential, Mass transfer.

The ozone molecule is formed by three oxygen atoms in an angular configuration. The O3 molecule is unstable, its heat of formation from diatomic oxygen is endothermic. The decay of ozone into dioxygen follows a slow first-order kinetics. This instability prevents ozone from being stored and shipped safely and economically and has to be produced on site. Ozone is a very strong oxidant. Aqueous solutions of ozone are not stable. The rate of decomposition of ozone in aqueous solutions depends on solution pH, temperature, and other parameters which are difficult to control, such as traces of reducing species in the water and the catalytic effects of the walls. Due to its redox potential the impact of ozone on microorganisms is much stronger than that of any other chemical disinfectant currently in use. The action of ozone on living cells is primarily in the form of an oxidative attack on the cell walls which eventually causes the cell to lyse. The most efficient way of producing ozone is via silent electrical discharge in an oxygen containing gas. The discharge creates free, energetic electrons which dissociate O2 molecules into oxygen atoms. Oxygen atoms are the intermediates in the formation and destruction reactions of ozone. The transfer of gaseous ozone into water is an essential step in the ozonation procedure. The mass transfer can best be described using the two-film-theory as a model. The driving force for mass transfer is the difference between the saturation concentration and the actual concentration in the bulk water. Ozonation of raw water with relatively small doses of ozone of the order of 0.1 to 1 g/cubic m is used in the pretreatment stages to remove the major fouling agents, including metal ions (iron and manganese), colloids, organics, and biological contaminants. (See also W89-13208) (Hammond-PTT)
W89-13223

TOWN BROOK RELIEF TUNNEL DESIGNING FOR ANOXIA AND H2S GENERATION.
Corps of Engineers, Waltham, MA. New England Div.
For primary bibliographic entry see Field 5G.
W89-13247

SIMULATION OF CHANGES IN STORMWATER QUALITY AT FOUR POTENTIAL FLOW-ATTENUATION SITES IN THE IRONDEQUOIT CREEK WATERSHED, MONROE COUNTY, NEW YORK.
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-13332

SOIL CHEMISTRY AND PHOSPHORUS RETENTION CAPACITY OF NORTH CAROLINA COASTAL PLAIN SWAMPS RECEIVING SEWAGE EFFLUENT.
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
C. J. Richardson, M. R. Walbridge, and A. Burns.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-193395/AS. Price codes: A06 in paper copy, A01 in microfiche. North Carolina Water-Resources Research Institute, Raleigh, Completion Report No. 241, November 1988. 82p, 7 fig, 11 tab, 73 ref. State project 70063.

Descriptors: *Swamps, *Wetlands, *Wastewater treatment, *Phosphorus removal, *North Carolina, *Soil chemistry, Sorption, Water pollution sources.

Several hundred freshwater swamps in North Carolina currently receive municipal wastewater inputs. In this study researchers examined three Coastal Plain wetlands to (1) characterize their soil chemical properties, (2) determine short-term and long-term effects of effluent additions on soil chemistry, (3) estimate the phosphorus sorption capacities of these swamp soils and determine the relationship between P sorption capacity and soil chemistry, and (4) develop a predictive index to evaluate the P sorption potentials of other N.C. Coastal Plain swamps. Despite similarities in vegetative cover, North Carolina Coastal Plain swamps were found to vary in soil characteristics and P sorption capacity, due to both natural and anthropogenic factors. Within a particular wetlands, soil chemical properties related to P sorption may also exhibit sapatial heterogeneity. (Lambert-UNC, WRRI)
W89-13353

FORMATION OF HALOGENATED ORGANICS DURING WASTEWATER DISINFECTION.
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
P. C. Singer, R. A. Brown, and J. F. Wiseman.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-193437/AS. Price codes: A08 in paper copy, A01 in microfiche. North Carolina Water-Resources Research Institute, Raleigh, Completion Report No. 239, November 1988. 135p, 29 fig, 47 tab, 59 ref. State project 70027.

Descriptors: *Trihalomethanes, *Chlorination, *Wastewater treatment, *Disinfection, *Organic compounds, North Carolina, Carcinogens.

This research examined the formation of trihalomethanes (THMs) and total organic halides (TOX) during wastewater chlorination at three wastewater treatment plants in the central Piedmont of North Carolina. Secondary effluent samples were collected before and after the addition of chlorine at each of the three treatment facilities; chlorinated samples were taken from various locations within the chlorine contact chambers and at the plant discharge. Water samples were also collected upstream and downstream from two of the plant outfalls to determine the increase and persistence of THMs and TOX below each plant. TOX and THM formation was evaluated in terms of effluent wastewater quality (e.g. residual chemical oxygen demand, total organic carbon and ammonia concentration), chlorine dose, chlorine contacting system, methods of chlorine addition, and chlorine-to-ammonia ratio. The result showed that TOX was present in the unchlorinated wastewater and that additional TOX was formed immediately after chlorine addition. Small to insignificant amounts of THMs were detected. TOX formation did not increase with increasing contact time, due to the rapid depletion of free chlorine and the formation of combined chlorine in the chlorine contact chamber. (Lambert-UNC, WRRI)
W89-13355

LIFETIME STUDIES AND OPTIMIZATION FOR AFT-TREATED ELECTRODIALYSIS MEMBRANES.
Georgia Inst. of Tech., Atlanta. Energy and Material Sciences Lab.
J. D. Shutt, E. S. K. Chian, J. A. Kearns, and L. J. Starks.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-193411/AS. Price codes: A07 in paper copy, A01 in microfiche. Final Report, April 1989. 142p, 90 fig, 16 tab, 27 ref, 10 append. Contract USGS 14-08-0001-G1492. Project Geo Tech A-4917-000.

Descriptors: *Wastewater treatment, *Electrodialysis, *Membranes, *Membrane coatings, *Optimization, *Antifoulants, Surfactants, Ion transport, Boundary layers, Langmuir-Blodgett process, Molecular design.

This work was conducted to determine the effect of Anti-Fouling Technology (AFT) treatment of electrodialysis (ED) membranes on system performance and lifetime. This study has helped to evaluate some of the critical performance parameters which must be considered in the application of AFT to the ED process. An experimental procedure was developed for coating membranes which were larger than any which had previously been coated using our apparatus. Although the data for the lifetime studies were not fully conclusive, they indicated that the application of an oriented monomolecular layer of a fluorinated surfac-

tant by the Langmuir-Blodgett process may prolong the operating life of electrodialysis membranes. A designed experiment was conducted in order to characterize the response of the system to changes in flow rates, concentration, foulant load, and the membrane coating showed that the coating appeared to lower the limiting current slightly. This is believed to be due to a lowering of the rate of ion transport across the boundary layer which is caused by the presence of the monolayer. The determination of the limiting current was subject to differences in interpretation since the current-voltage characteristic was somewhat anomalous. (USGS)
W89-13356

BINDING OF XENOBIOTICS TO HUMIC MATERIAL IN THE AQUATIC ENVIRONMENT.
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
For primary bibliographic entry see Field 5G.
W89-13360

WATER PURIFICATION AND WASTE CONCENTRATION BY THE VACUUM FREEZING MULTIPLE PHASE TRANSFORMATION PROCESS AND ITS EUTECTIC EXTENSION.
Calyxes Research and Development Corp., Albuquerque, NM.
For primary bibliographic entry see Field 3A.
W89-13383

SELECTIVE REMOVAL OF TRACE ORGANICS USING SURFACE GRAFTED POLYMERS.
California Univ., Los Angeles. Dept. of Chemical Engineering.
Y. Cohen.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-214480/AS. Price codes: A04 in paper copy, A01 in microfiche. Final Report, August 1988. 65p, 27 fig, 4 tab, 54 ref, append. USGS Contract 14-08-0001-G1315.

Descriptors: *Adsorption, *Polymers, *Adsorbents, *Wastewater treatment, *Organic wastes, *Resins, *Polymerization, Trace organics, Phenols, Trichloroethylene, Chloroform.

The objectives were to develop and evaluate polymeric resins for the selective removal of trace organics from contaminated water supplies and wastewater streams. Available polymeric adsorbents and novel polymer-silica resins were evaluated as potential adsorbents for the selective removal of organic contaminants in aqueous systems. An adsorption data base was developed for the adsorption of trichloroethylene, chloroform and phenol, onto a variety of adsorption resins. The affinity of various resins for the adsorption of the above organics was evaluated based on the amount of adsorbed solute/available surface area. The possibilities of removing organics for aqueous systems using hydrophilic polymeric resins was demonstrated, for the first time, for phenol adsorption. These latter resins were polymeric-silica matrix resins which were synthesized using a novel technique of graft polymerization. The results of the current study have shown that polymer-silica matrix resins can be potentially useful adsorption resins for the selective removal of organics. (USGS)
W89-13397

5E. Ultimate Disposal Of Wastes

FATE AND TRANSPORT OF BIOLOGICAL AND INORGANIC CONTAMINANTS FROM ON-SITE DISPOSAL OF DOMESTIC WASTEWATER.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W89-12173

APPLICATION OF SEWAGE SLUDGE AND OTHER AMENDMENTS TO COAL REFUSE MATERIAL: I. EFFECTS ON CHEMICAL COMPOSITION.
Metropolitan Sanitary District of Greater Chicago, IL. Dept. of Research and Development.
R. I. Pietz, C. R. Carlson, J. R. Peterson, D. R. Zen, and C. Lue-Hing.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 164-169, April/June 1989. 4 fig, 4 tab, 18 ref.

Descriptors: *Land disposal, *Sludge disposal, *Soil amendments, *Land reclamation, *Waste disposal, *Mine wastes, Lime, Gypsum, Wastewater, Sludge, Chemical composition, Coal refuse material, Illinois, Leaching.

The effects of sewage sludge, lime, and gypsum on the chemical composition of coal refuse material were examined at a Fulton County (Illinois) land reclamation site. Treatments consisted of a control, 542 dry Mg/ha anaerobically digested sewage sludge, 89.6 Mg/ha lime, 112 Mg/ha gypsum, and combinations of these amendments. Analysis of coal refuse material (0-15 cm) from 1976 to 1981 showed that the sewage sludge + lime treatment was the most effective in maintaining the refuse pH, and in reducing water-soluble Al and Fe, KCl extractable Al and total acidity. Gypsum applications decreased the refuse pH and increased water-soluble Al and Fe, KCl extractable Al, and total acidity. The effectiveness of treatment in reducing total acidity was sewage sludge + lime > gypsum + sewage sludge + lime > sewage sludge > lime > gypsum + sewage sludge > control > gypsum + lime > gypsum. Concentrations of water-soluble Ca, Mg, and Na reflected the additions of these cations made by various treatments and the contribution of these cations to refuse electrical conductivity (EC). Profile sampling (0-100 cm) in 1976 and 1981 showed a decline in pH, and an increase in water-soluble Al and Fe and total acidity in 1981 samples from the sewage sludge ad gypsum treatments. The changes in the sludge treatment indicate there was a solubilization of metals from the refuse material and sewage sludge with lime, as the surface pH (0-15 cm) declined, and a subsequent increase in the total acidity from metals and acidic by-products leached to the 15 to 100 cm depths of the coal refuse material. In the gypsum treatment, the changes observed in the 1981 profile samples reflected the leaching of H3O(+), metals, and acidic by-products of pyrite oxidation produced by exchange with Ca from the gypsum amendment. (See also W89-12179 and W89-12180) (Author's abstract)
W89-12178

APPLICATION OF SEWAGE SLUDGE AND OTHER AMENDMENTS TO COAL REFUSE MATERIAL: II. EFFECTS ON REVEGETATION.
Metropolitan Sanitary District of Greater Chicago, IL. Dept. of Research and Development.
R. I. Pietz, C. R. Carlson, J. R. Peterson, D. R. Zen, and C. Lue-Hing.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 169-173, April/June 1989. 3 tab, 29 ref.

Descriptors: *Land disposal, *Sludge disposal, *Soil amendments, *Land reclamation, *Vegetation effects, *Waste disposal, *Mine wastes, *Revegetation, Lime, Gypsum, Wastewater, Sludge, Coal refuse material, Illinois, Alfalfa, Grasses, Heavy metals, Phytotoxicity.

The effects of sewage sludge, lime, and gypsum on the revegetation of acidic coal refuse material were studied at a Fulton County (Illinois) land reclamation site. Treatments consisted of control, 542 dry Mg/ha anaerobically digested sewage sludge, 89.6 Mg/ha lime, 112 Mg/ha gypsum and combinations of these amendments. The experimental plots were seeded with a mixture of bromegrass (Bromus inermis Leyss.), tall fescue (Festuca arundinacea L.), and alfalfa (Medicago sativa L.). Yearly analysis of coal refuse material (0-15 cm) showed that the concentrations of NH4(+)-N, (NO3(-)+NO2(-))-N, available P, and water-soluble K were the highest in sludge-amended treatments, but they decreased with time. Plant yields increased each year from 1978 to 1980 in treatments receiving lime, sewage sludge, or both amendments. THe highest yield of 6.00 Mg/ha occurred in the 1980 sludge + lime treatment. In 1980, the order of dry matter plant yields by treatments was sewage sludge + lime > gypsum + sewage sludge + lime > sewage sludge > gypsum + sewage sludge > gypsum + lime > gypsum = control. Coal refuse and tissue K levels indicated that supplemental K would be desirable for long-term maintenance of a vegetative cover. The better survival of bromegrass and tall fescue, as compared to alfalfa, reflected the coal refuse pH and the shorter root system of the more acid-tolerant grasses. Concentrations of Al, Fe, Pb, and Zn in composite plant samples from some treatments exceeded the phytotoxic limits for these metals in plants. Potential plant toxicity from metals in the coal refuse material was most likely reduced by reactions with the applied sewage sludge and lime. (See also W89-12178 and W89-12180) (Author's abstract)
W89-12179

APPLICATION OF SEWAGE SLUDGE AND OTHER AMENDMENTS TO COAL REFUSE MATERIAL: III. EFFECTS ON PERCOLATE WATER COMPOSITION.
Metropolitan Sanitary District of Greater Chicago, IL. Dept. of Research and Development.
R. I. Pietz, C. R. Carlson, J. R. Peterson, D. R. Zen, and C. Lue-Hing.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 174-179, April/June 1989. 4 fig, 4 tab, 20 ref.

Descriptors: *Land disposal, *Sludge disposal, *Soil amendments, *Land reclamation, *Waste disposal, *Mine wastes, *Percolating water, Lime, Gypsum, Wastewater, Sludge, Coal refuse material, Illinois.

The effects of sewage sludge, lime, and gypsum on the revegetation of acidic coal refuse material were studied at a Fulton County (Illinois) land reclamation site. Treatments consisted of control, 542 dry Mg/ha anaerobically digested sewage sludge, 89.6 Mg/ha lime, 112 Mg/ha gypsum and combinations of these amendments. The chemical composition of the percolate collected monthly (1976 to 1980) from suction lysimeters at a 1-m depth reflected the treatments applied to the coal refuse material. Percolate pH, NH4(+)-N and (NO3(-)+NO2(-)-N levels were lowest in either the gypsum or control treatments and highest in the sewage sludge treatment and declined with time, while P levels remained at < 2.3 mg/L. Percolate SO4 levels were lowest in either the control or sludge-amended treatments. Percolate concentrations of Al, Cr, Cu, Fe, and Zn were lowest in the sewage sludge treatment and highest in gypsum-amended treatments. Metal solubility in the percolate was affected by the chemical composition of the coal refuse material and the applied amendments. Percolate Al, Cd, Cr, Cu, Fe, Ni, and Zn levels were negatively related to pH in the sludge and sludge + lime treatments. Estimated concentrations the various metals at a specific pH indicates that the sludge and sludge + lime treatments were very effective in reducing metal leaching when the percolate pH was > or = 5.0. The application rates of lime and sewage sludge based on theoretical procedures were effective for about 5 years. For long-term (> 5 years) reclamation, the effectiveness of the sludge and sludge + lime treatments would be better maintained by applying more sludge (1050 Mg/ha) and (900 to 1350 Mg/ha) + lime (134 to 189 Mg/ha) initially. The factor of two difference between the theoretical and actual amounts of lime and sewage needed in the field suggests that an added safety factor of 1.5 to 2 for application of these amendments is desirable for long-term reclamation of coal refuse material. (See also W89-12178 and W89-12179) (Author's abstract)
W89-12180

CHEMICAL PROPERTIES OF METAL-HUMIC ACID FRACTIONS OF A SEWAGE SLUDGE-AMENDED ARIDISOL.
Bari Univ. (Italy). Ist. di Chimica Agraria.
N. Senesi, G. Sposito, K. M. Holtzclaw, and G. R. Bradford.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 186-194, April/June 1989. 5 fig, 6 tab, 30 ref. Department of the Interior Matching Grant

Program of the Public Law 95-467, Project no. B-212-CAL and University of California Water Resources Center, Project UCAL-WRC-W-583.

Descriptors: *Sludge disposal, *Soil amendments, *Heavy metals, *Waste disposal, *Humic acids, *Cropland, Wastewater, Sludge, Barley, Chemical composition, Aridisol, Sorghum, Spectroscopy, Chemical speciation.

Humic acid (HA) was extracted from a Domino soil (Xerolloc Calciorthids) cropped with barley (Hordeum vulgare L.) and sorghum (Sorghum bicolor (L.) Moench) in experimental plots that received applications of sewage sludge for 4, 5, 6, or 7 years at rates of 0, 22.5, 45, or 90 Mg/ha/yr. The HA samples were characterized chemically by elemental and functional group analyses, total trace metal content, infrared (IR) and electron spin resonance (ESR) spectroscopy. As compared to the nonamended Domino (Xerollic Paleorthids) soil HA, the highest sludge-amended soil HA was extracted in higher yields and had higher N and S contents, lower C/N molar ratios, higher total acidity, and phenolic OH content, lower organic free radical content, and higher relative intensity of the amide I and amide II IR absorption bands. These differences are believed to be caused by the incorporation of components typical of the applied sludge organic fraction into soil HA. The Ha also exhibited a well-defined selectivity in respect to trace metal adsorption/desorption. Copper, Ni, Zn, Fe, Cr, were adsorbed strongly into readily available sites, or through exchange with more weakly adsorbed trace metal ions (Mn, V, Ti, and Mo). However, the soil HA tended to reach metal saturation at the highest sludge application rates. The ESR analysis showed the presence of indigenous Cu(++), Fe(+++), and VO(++)-HA complexes in all HA samples. These complexes had similar chemical and structural properties, and were concluded to represent the speciation of the metals in association with HA. In general, the impact of the organic constituents in fresh sludge on the soil HA appeared to be mitigated somewhat by the continual tendency of soil organic matter to attain equilibrium, whereas the metal-organic portion of the soil HA was significantly affected by sludge application. (Author's abstract)
W89-12181

PRESSURIZED LAYER REDUCES TRANSPORT THROUGH COMPACTED CLAY LINERS.
Iowa State Univ., Ames. Dept. of Agronomy.
G. J. Kluitenberg, and R. Horton.
Journal of Environmental Quality JEVQAA, Vol. 18, No. 2, p 228-232, April/June 1989. 4 fig, 13 ref.

Descriptors: *Hazardous materials, *Waste disposal, *Landfills, *Landfill linings, *Solute transport, *Materials engineering, *Leaching, *Path of pollutants, Clays, Chemical transport, Pressurized layers.

Compacted clay liners are often used in hazardous waste surface impoundments and landfills to provide a physical barrier to the flow of leachate. If a line develops cracks or regions of high conductivity, convective fluxes can lead to increased chemical transport through the liner. The use of a pressurized layer of coarse material sandwiched between two compacted clayey soil layers to eliminate the hydraulic gradient across the upper layer is investigated. The hypothesis is that such a system would limit convective transport through cracks or regions of high conductivity. Miscible displacement experiments were conducted using compaction permeaters filled with layered and unlayered soil materials. Experiments were carried out with and without a worst case hole penetrating the soil column vertically. The experimental results show that, mean solute travel times and times to first breakthrough were significantly greater than when no interlayer was used. Travel times and time to first breakthrough were also increased when the pressurized interlayer was introduced in a column not containing a hole. The experimental results also serve to the demonstrate the devastating effect of a small crack or hole in solute transport. (Author's abstract)
W89-12185

HEALTH GUIDELINES FOR THE USE OF WASTEWATER IN AGRICULTURE AND AQUACULTURE.
World Health Organization, Geneva (Switzerland).
World Health Organization.
World Health Organization Technical Report Series WHOTAC, No. 778, 1989. 5 fig, 6 tab, 33 ref, 2 append.

Descriptors: *Wastewater disposal, *Public health, *Waste disposal, *Wastewater, *Municipal wastewater, *Agriculture, *Aquaculture, Health effects, Interagency cooperation, Research priorities.

The use of wastewater in agriculture and aquaculture is reviewed from the point of view of its health effects. Guidelines and alternative measures for the control of infectious disease transmission are recommended and the needs for further research and development are identified. It is concluded that municipal wastewater is a valuable resource which should be used wherever this is possible with adequate health safeguards. The advantages of such use include the consequent reduction in environmental pollution as well as increased agricultural production. Reuse of wastewater in agriculture and aquaculture should, where possible, be the preferred method of wastewater disposal and should form an integral part of water resources planning. Health protection in wastewater reuse can be achieved by an integrated set of measures which may include wastewater treatment, crop restriction, appropriate wastewater application techniques and human exposure control. The optimum combination of measures will depend on local conditions and the specific groups of people to be protected. Improved epidemiological information and understanding now permit the adoption of more rational standards for the microbiological quality of treated wastewater for use in agriculture. The use of raw or inadequately treated wastewater without sufficient health safeguards has often been tolerated, partly because some previous standards and regulations have been too strict to be achievable. In the selection of wastewater treatment techniques for reuse schemes, the primary consideration should be their ability to remove pathogens consistently; it should be borne in mind that conventional systems are less likely to be reliable in this respect. Effective implementation of health protection measures in wastewater reuse requires the involvement and cooperation of several ministries and government agencies, whose activities need to be coordinated. (Miller-PTT)
W89-12188

ANALYTICAL INVERSE MODELING OF REGIONAL-SCALE TRITIUM WASTE MIGRATION.
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W89-12189

ONSITE WASTEWATER TREATMENT AND DISPOSAL FOR COASTAL RESORT BUSINESSES.
Drexel Univ., Philadelphia, PA.
For primary bibliographic entry see Field 5D.
W89-12230

CRITERIA FOR SEWAGE TREATMENT AND DISPOSAL IN A TOURIST CITY.
Gold Coast City Council (Australia). Planning and Design.
For primary bibliographic entry see Field 5D.
W89-12239

IMPACT OF LAGOON EFFLUENT ON AN INLAND STREAM: A 10 YEAR PERSPECTIVE.
WSL Consultants Pty Ltd., Richmond (Australia).
G. P. Skerry, and J. G. Parker.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 289-292, 1989. 1 tab.

Descriptors: *Water pollution effects, *Lagoons, *Wastewater disposal, *Wastewater outfall, *Water pollution control, *Water quality, *Recreation, *Irrigation, *Australia, Nutrients, Nitrogen, Organic carbon, Salinity, Goulburn River.

The discharge of lagoon treated effluent to inland waterways has long been of contention in relation to the impact of residual algal cells and nutrients in the receiving water body, especially one used extensively for recreation. The pre-lagoon and post-lagoon discharge effects on water quality were examined in a major inland river, the Goulburn River, Victoria, over a 10-year monitoring period from 1977-1987. The impact of a lagoon discharge flow of up to 20 megaliters/day during summer conditions is assessed in relation to the effect on receiving stream physical, chemical and biological water quality indicators. Results have demonstrated that water quality has been maintained so that the water remains stable for recreational and irrigation usages. Water quality in the upstream storages is good at Lake Eildon and the Nagambie weir but less satisfactory at Lake Mokoan. The Daldy Road Lagoons at Shepparton represent the major point discharge source to the Goulburn River system, treating wastes equivalent to a population of 360,000. The monitoring program confirms that by management of nitrogen inputs to the lagoons, adjustment can be achieved with minimal exchange to receiving water quality. By a combination of storage and reuse of effluent during the summer period, inputs of nutrients, organic carbon and salinity to the river are minimized during the critical peak summer period. (Author's abstract)
W89-12244

PHYSICAL AND CHEMICAL BEHAVIOR OF STABILIZED SEWAGE SLUDGE BLOCKS IN SEAWATER.
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
C.-S. Shieh, and F. J. Roethel.
Environmental Science and Technology ESTHAG, Vol. 23, No. 1, p 121-125, January 1989. 4 fig, 5 tab, 26 ref.

Descriptors: *Waste disposal, *Sludge disposal, *Ocean dumping, *Water quality standards, Heavy metals, Fly ash, Gypsum, Lime, Portland cements, Physical properties, Chemical properties, Leaching, Permeability, Cadmium, Lead, Chromium, Arsenic, Aluminum, Copper, Zinc, Seawater.

Dewatered sewage sludge (20% solids) was successfully stabilized into block form by using fly ash, gypsum, lime, and Portland cement. Physical and chemical properties, including leachate test, of selected mixes were determined to evaluate the effectiveness of stabilization. The permeability of the stabilized blocks decreased from about 100 to 45 nm/s over 330 h and compressive strength ranged between 2000 and 2600 kPa and was found to increase with time after submerging in seawater. Cd, Pb, Cr, and As were found in the EP leachate, but their concentrations were lower than the maximum regulatory concentrations established by the EPA. Concentrations of Al, Cu, Zn, and Pb in the exterior portions (< 1 cm) of the sewage sludge blocks increased with time after exposure to seawater, suggesting readsorption of Al, Cu, Zn, and Pb onto the seawater submerged stabilized blocks. The concentration of Cd, however, decreased with time. The results indicated that the stabilized sewage sludge blocks maintain their structural integrity in seawater and would be classified as a nonhazardous material. (Author's abstract)
W89-12384

LEACHING OF HEAVY METALS FROM COMPOSTED SEWAGE SLUDGE AS A FUNCTION OF PH.
Indiana Univ. of Pennsylvania. Dept. of Chemistry.
S. L. Tackett, E. R. Winters, and M. J. Puz.
Canadian Journal of Soil Science CJSSAR, Vol. 66, No. 4, p 763-765, November 1986. 2 tab, 7 ref.

Descriptors: *Leaching, *Sludge disposal, *Acidity, *Heavy metals, *Land disposal, Composting, Cadmium, Copper, Iron, Lead, Zinc, Atomic ab-

sorption spectroscopy, Hydrogen ion concentration.

The relative short-term leaching rates of the metals Cd, Cu, Fe, Pb, and Zn from composted sewage sludge was determined over the pH range of 2.5-7.0 at 0.5 pH unit intervals. Only Zn and Cd leached significantly faster as the pH was lowered, with both showing the greatest solubility increase over the pH range of 5.5-6.0. Results support the previous cautions already cited for the land-spreading of sewage sludge, and suggest areas of special concern. Both Zn and Cd increase in solubility with decreasing pH. Zinc shows the largest increase, but Cd is highly toxic to animals and is readily absorbed by plants. Care should be taken to use only sludges with very low Cd contents, and moderately low Zn contents, and to maintain soil pH values above 6.5 during and after sludge application. While Fe, Pb, and Cu solubilities were not affected over the short term by lowering pH values, Pb does pose a potentially serious problem. The Pb contents found in the leachates in all pH values were higher than the presently certified safe drinking water limit of 0.050 ppm. Since maintaining a high pH does not prevent the short-term leaching of small amounts of Pb, sludges should be approved for land application only if they have very low Pb contents. (Doria-PTT)
W89-12428

HEAVY METAL CONCENTRATION IN HALTON REGION SOILS: AN ASSESSMENT FOR FUTURE MUNICIPAL SLUDGE UTILIZATION.
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
M. D. Webber, and A. Shamess.
Canadian Journal of Soil Science CJSSAR, Vol. 67, No. 4, p 893-903, November 1987. 2 fig, 2 tab, 12 ref.

Descriptors: *Heavy metals, *Ontario, *Soil chemistry, *Cropland, *Land disposal, *Sludge disposal, *Sludge utilization, Lead, Zinc, Sulfides, Sampling, Atomic absorption spectroscopy, Arsenic, Cadmium, Cobalt, Chromium, Copper, Mercury, Nickel.

Studies were conducted to determine the heavy metal concentrations in Halton Region (Ontario) agricultural soils. Soil samples were taken on a regular grid pattern from the agricultural area of the Region. In a very large proportion of the samples, heavy metal concentrations were less than the maximum permissible values for sludge application to land in Ontario and in most of the samples, they were less than or approximately equal to the mean values for uncontaminated soils in Ontario. In a small proportion of the samples, heavy metal concentrations exceeded the maximum permissible values for sludge application to land in Ontario. These samples were obtained mainly west of the Niagara Escarpment in the southwest corner of the Region and the offending metals were primarily Pb and Zn. High Pb and Zn concentrations in these soils were not related to sludge application but were naturally occurring and probably were derived by Pb and Zn sulfides in the soil parent material. It was concluded that sludge may be applied on a very large proportion of the agricultural land in Halton Region. (Author's abstract)
W89-12431

COLLOIDS IN WATER FROM A SUBSURFACE FRACTURE IN GRANITE ROCK, GRIMSEL TEST SITE, SWITZERLAND.
Paul Scherrer Inst., Wuerenlingen (Switzerland).
For primary bibliographic entry see Field 5B.
W89-12474

ANALYSIS BASED ON INTEGRATED CONSERVATION LAW FOR DISCONTINUOUS ROCK: COUPLED ANALYSIS OF STRESS, HEAT TRANSFER AND GROUNDWATER FLOW.
Saitama Univ., Urawa (Japan). Faculty of Technology.
For primary bibliographic entry see Field 5B.
W89-12475

MOVEMENT OF VIRUSES AFTER ARTIFICIAL RECHARGE.
Webster (Arthur) Pty Ltd., Baulkham Hills (Australia).
J. Jansons, L. W. Edmonds, B. Speight, and M. R. Bucens.
Water Research WATRAG, Vol. 23, No. 3, p 293-299, March 1989. 3 fig, 5 tab, 24 ref.

Descriptors: *Enteroviruses, *Artificial recharge, *Path of pollutants, *Wastewater irrigation, Groundwater recharge, Soil water, Wastewater facilities.

Results of human enteric virus movement through soil and groundwater aquifers after artificial recharge using wastewater are presented. The penetration through the recharge soil of indigenous viruses from treatment plant effluent was found to be much greater than that of a seeded vaccine poliovirus. Echovirus type 11 from wastewater was detected at a depth of 9.0 meters in groundwater from a bore located 14 meters from the recharge basin whereas seed poliovirus was not isolated beyond a depth of 1.5 meters below the recharge basin. It was concluded that data on enteric virus survival in groundwater were required if safe abstraction distances were to be determined. (Author's abstract)
W89-12481

SURVIVAL OF VIRUSES IN GROUNDWATER.
Webster (Arthur) Pty Ltd., Baulkham Hills (Australia).
J. Jansons, L. W. Edmonds, B. Speight, and M. R. Bucens.
Water Research WATRAG, Vol. 23, No. 3, p 301-306, March 1989. 4 fig, 3 tab, 23 ref. Water Authority of Western Australia Grant.

Descriptors: *Groundwater pollution, *Artificial recharge, *Path of pollutants, *Enteroviruses, Groundwater, Temperature control, Dissolved oxygen, Microorganisms, Infection, Boreholes.

Survival in groundwater, after artificial recharge of wastewater treatment plant effluent, of echovirus types 6, 11, and 24, coxsackievirus type B5, and poliovirus type 1 was determined. Enterovirus survival in groundwater was found to be variable and appeared to be influenced by a number of factors: temperature, dissolved oxygen concentration, and possible the presence of microorganisms. Dissolved oxygen concentration was the most significant factor in loss of virus infectivity in groundwater. Poliovirus type 1 incubated in groundwater with a mean dissolved oxygen concentration of 0.2 milligrams per liter decreased in infectivity by 100-fold in 50 days compared with 20 days for a decrease of the same magnitude when incubated in groundwater with a mean dissolved oxygen concentration of 5.4 milligrams per liter. Echovirus type 6 was found to be least stable, and poliovirus type 1 was found to be most stable, although virus stability may have been due to conditions existing in individual groundwater bores. (Author's abstract)
W89-12482

MARKET ANALYSIS FOR MULTI-COMPOST PRODUCTS.
Cal Recovery Systems, Inc., Richmond, CA.
L. L. Eggerth, L. F. Diaz, and S. Gurkewitz.
Biocycle BCYCDK, Vol. 30, No. 5, p 29-34, May 1989. 3 fig, 3 tab.

Descriptors: *Recycling, *Waste disposal, *Compost, *Sludge, *Soil amendments, *Municipal wastes, *Market value, *Economic aspects, Chemical properties, Physical properties, Biological properties, Solid wastes, Cost analysis, Evaluation, Portland.

A study was conducted to determine if three compost products (yard debris, sewage sludge, and municipal solid waste) could successfully compete in metropolitan Portland, Oregon, involving three major components: a technical analysis of the physical, chemical, and biological characteristics of the three compost materials; an evaluation of transportation costs and potential markets in terms of geographic area; and an evaluation of the current market structure and an assessment of the future market for the composts. It was found that the major market for soil amendments is the residential sector, accounting for the major usage of yard debris compost, followed by landscapers and public agencies. Sewage sludge compost is preferred by landscapers and nurserymen. The future of the soil amendment market in the metropolitan Portland area appears to be related to a number of factors including the economy, population growth, and the weather, and is also affected by a number of factors including: consistent quality, cost, availability, and user understanding of the benefits and/or limitations of each of the three products. Due to the differing characteristics and potential uses of the three compost products, combined with the results of the market survey and the current marketing strategy for municipal solid waste compost, it was concluded that the introduction of this compost would not negatively affect the market programs for yard debris and sewage sludge composts already in existence. The long-term stability of the markets for municipal solid waste compost, as well as its impact on the other composts, will be a function of quality of material as well as price. (Fish-PTT)
W89-12494

SLUDGE TREATMENT, UTILIZATION, AND DISPOSAL.
Metcalf and Eddy, Inc., Wakefield, MA.
For primary bibliographic entry see Field 5D.
W89-12512

ON-SITE ALTERNATIVES FOR TREATMENT AND DISPOSAL.
ENSR Contractors, Acton, MA.
For primary bibliographic entry see Field 5D.
W89-12513

LAND APPLICATION OF WASTEWATER.
Dames and Moore, Atlanta, GA.
For primary bibliographic entry see Field 5D.
W89-12517

RADIOACTIVE WASTES.
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
B. M. Thomson.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 901-905, June 1989. 84 ref.

Descriptors: *Wastewater treatment, *Literature review, *Radioactive waste disposal, *Radioactive wastes, Planning, Waste repositories, Waste processing, Waste decommissioning, Precipitation, Ion exchange, Low-level radioactive wastes, High level radioactive wastes, Case studies.

A review of recent studies on radioactive wastes includes: (1) National programs to investigate acceptable disposal sites, develop an interagency radiation policy, and review European radwaste management; (2) Waste repository considerations such as alternative media for geologic disposal, the volatility of cesium and strontium from basalt, performance of surface disposal sites for low-level radioactive wastes, and the natural radionuclides of the uranium and thorium decay chains; (3) Waste processing and decommissioning which include preparations for removal and transporting of a damaged core, the dismantling of a reactor internals, reprocessing techniques, conversion and solidification of high level wastes, and the cracking of vitrified wastes and canisters; (4) The occurrence and treatment of radon, radium and uranium in drinking water supplies; and (5) Remedial action and treatment available for removing radium-226 and thorium-230 from uranium ores and mill tailings, and the use of chemical precipitation and ion exchange for treatment of low-activity wastewaters. (White-Reimer-PTT)
W89-12531

HAZARDOUS AND SOLID WASTES.

Dames and Moore, Atlanta, GA.
J. Zirschky.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 905-910, June 1989. 147 ref.

Descriptors: *Water pollution sources, *Literature review, *Hazardous materials, *Solid wastes, *Solid waste disposal, Regulations, Waste reduction, Incineration, Biological treatment, Sampling, Monitoring, Groundwater contamination, Landfills, Risks.

A review of recent studies on hazardous and solid wastes includes: (1) General studies concerning hazardous waste characteristics, regulations, treatment, and sampling; and similarities in radioactivity and chemical waste disposal technologies and policies; (2) Waste minimization techniques; (3) Treatment techniques for halogenated organic, corrosive, and cyanide wastes; biological treatment; incineration; soils treatment; photolysis; and stabilization; (4) Remediation techniques from a guidance manual; costs; and landfill revegetation; (5) Sampling and monitoring considerations such as statistical considerations for groundwater monitoring, sampling procedures for estimating waste disposal tonnage at landfills, and methods for characterizing solid wastes; (6) Landfill design and inspection procedures for landfill liners, grout permeability to hazardous wastes, leachate from landfills, and gas migration from landfills; and (7) Risk assessments. (White-Reimer-PTT)
W89-12532

EFFECT OF DIKES AND SULFURIC ACID ON COTTON UNDER EFFLUENT IRRIGATION.

Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
G. Oron, and Y. DeMalach.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 463-473, June 1989. 2 fig, 9 tab, 12 ref.

Descriptors: *Wastewater irrigation, *Dikes, *Arid climates, *Cotton, *Water supply, *Crop yield, *Irrigation design, *Sulfuric acid, Agricultural hydrology, Agriculture, Loess, Alkaline soils, Sprinkler irrigation, Trickle irrigation, Israel, Runoff.

Extensive efforts are being undertaken to improve effluent use in arid zones with alkaline soils. In Israel, this type of soil (loess), with a relatively large amount of water loss due to runoff generation, is mainly found in the south. The possibility of decreasing runoff, soil erosion, improving water intake rate, and obtaining economic cotton yields was examined in a series of field experiments. Various combinations of dike construction between cotton rows and sulfuric acid applications were examined. Results showed that sulfuric acid significantly reduced runoff reduction and improved water infiltration, and that the acid treatment improves water intake and cotton yield more significantly than that of the dikes, under sprinkler and trickle irrigation systems. (Author's abstract)
W89-12639

PARTICLE FILTRATION FOR WASTEWATER IRRIGATION.

Hebrew Univ. of Jerusalem (Israel). Human Environment Sciences Div.
A. Adin, and M. Elimelech.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 474-487, June 1989. 11 fig, 17 ref, append.

Descriptors: *Irrigation practices, *Wastewater renovation, *Wastewater irrigation, *Filtration, *Particulate matter, *Irrigation engineering, Irrigation, Effluents, Activated sludge, Contact beds, Particle size, Trickle irrigation, Turbidity, Suspended solids.

Conventional water filtration methods cannot be generalized for use in direct wastewater filtration for drip (trickle) irrigation systems. Effluents from an oxidation ponds-reservoir system and from an activated sludge plant were filtered through granular beds and filter screens, for the purpose of evaluating particle filterability. The granular beds remove particles larger than 10 microns with an efficiency of 40 to 85%, depending on the existence of surface straining and effluent type, whereas smaller particles (1-2 microns in size) are hardly removed, suggesting that minimum transport theory applies. The removal ratio for all particles measured increases with grain size and with bed depth, and decreases with filtration velocity, affecting the lower particle size range more. Filter screens clog very rapidly even though they remove only about 1-2% of the total suspended solids (TSS). Both turbidity and TSS are inferior to particle size distribution measurements for filterability evaluation of wastewater effluents. (Author's abstract)
W89-12640

BACTERIOLOGICAL AND CHEMICAL STUDIES OF WASTEWATER FROM A CHEMICAL FERTILIZER PLANT.

Assiut Univ. (Egypt). Dept. of Botany.
S. M. Mohawed, M. A. Meki, and S. S. Ismail.
Biological Wastes BIWAED, Vol. 28, No. 3, p 227-232, 1989. 2 tab, 10 ref.

Descriptors: *Chemical wastewater, *Wastewater pollution, *Fertilizer plants, *Nile River, Egypt, Bioindicators, Bacterial analysis, Chemical analysis, Chemical wastes, Heterotrophic bacteria.

During 1984 and 1985, a physicochemical analysis of the wastewaters from the nitrate fertilizer industry in the Aswan area was conducted, and heterotrophic bacterial populations, which developed during the journey of the wastewater in the Kima canal before it joins the River Nile, were investigated. Principal wastewater parameters which were found to deviate significantly from set standards were: NO3(-), NO2(-), SO4, Cl, total alkalinity, COD, and free NH3. Mesophilic and heterotrophic populations (1200/ml) exceeded thermophilic ones (300/ml), and psycrophilic ones were not observed. Gram-negative rods, spore-formers, nitrate-reducers, catalase-positive organisms and non-producers of H2S and indole were the predominant types. Apparently these bacteria adapt themselves to new and adverse environments. Biological indicators of industrial wastewater effects are apparent, and it is thought that bacteria are responsible for many of the chemical processes in Kima canal water. It is concluded that Kima industrial wastewater is unsuitable for introduction into the River Nile. (White-Reimer-PTT)
W89-12667

FIELD STUDIES: HARDY ROAD LANDFILL AND INDUSTRIAL EXCESS LANDFILL, A SUPERFUND SITE.

Akron Univ., OH. Center for Environmental Studies.
J. L. Jackson, J. R. Bauder, J. Hardy, and M. S. Kennedy.
Ohio Journal of Science OJSCA9, Vol. 89, No. 3, p 45-55, June 1989. 9 fig, 2 tab 19 ref.

Descriptors: *Industrial wastes, *Geology, *Waste disposal, *Landfills, *Ohio, *Geomorphology, *Groundwater pollution, *Superfund, Hydrology, Groundwater movement, Field tests, Standards, Legislation, Glacial sediments, Lake sediments, Leachates, Sandstones, Shales, Observation wells.

Two waste disposal sites, Akron's Hardy Road Landfill in Northampton Township and Industrial Excess Landfill in Uniontown, Ohio were visited as part of the Geological Society of America North-Central Regional Meeting held in April 1988. The sites were chosen to demonstrate the significance of geologic conditions at waste disposal sites. The two sites were first used for waste disposal in the 1960's. Therefore, early operations at the sites predate the extensive guidelines and legislation presently governing waste disposal. At the Hardy Road Landfill geologic conditions contributed to off-site methane migration in 1984, resulting in destruction by fire of a private dwelling. Gas migration is now controlled by an active gas collection system. Sand and gravels deposited during multiple glacial events are underlain by lacustrine silts and clays. These lacustrine deposits and the hydrology of the site are expected to control leachate. The glacial deposits are up to 150 m thick in the buried valley beneath the site. The major concern at the Uniontown site is ground water contamination. Sandstone and shale bedrock of the site area belong to the lower Pottsville Group of the Pennsylvanian strata. Groundwater samples analyses indicated a surprisingly low level of contamination for monitor wells within and very near a sand and gravel deposit. It is believed a combination of till in the site, compaction, type of waste, cover material, and local ground water recharge areas have significantly reduced movement of contaminants off site. (White-Reimer-PTT)
W89-12706

TRANSMISSION OF ENTERIC DISEASE ASSOCIATED WITH WASTEWATER IRRIGATION: A PROSPECTIVE EPIDEMIOLOGICAL STUDY.

Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
H. I. Shuval, Y. Wax, P. Yekutiel, and B. Fattal.
American Journal of Public Health AJHEAA, Vol. 79, No. 7, p 850-852, July 1989. 3 tab, 12 ref. USEPA grant no. CR-806416.

Descriptors: *Path of pollutants, *Human diseases, *Wastewater disposal, *Wastewater irrigation, *Pathogens, *Enteric bacteria, *Epidemiology, Aerosols, Sprinkler irrigation, Israel, Public health, Population exposure.

A prospective study was conducted of the possible enteric disease transmission by aerosolized pathogens from sprinkler irrigation of partially treated wastewater in 20 kibbutzim (collective agricultural settlements) in Israel between March 1981 and February 1982. Medical data were collected from the patients' files and daily logs of physicians and nurses at each kibbutz clinic (total population 10,231). Episodes of enteric disease were similar in the kibbutzim most exposed to wastewater aerosols (11.6 per 100 person-year) and the kibbutzim not exposed to wastewater in any form (11.0 per 100 person-year). No excess of enteric disease was seen among wastewater contact workers or their families as compared with the unexposed. No negative health effects were detected in this study, which involved a large population (including many young children) exposed to treated wastewater aerosols generated at distances of 300-600 m. (Author's abstract)
W89-12729

REGIONAL APPROACH TO SLUDGE MANAGEMENT.

Dufresne-Henry, Inc., North Springfield, VT.
M. E. Lang, S. D. Freedman, and T. D. Nesbitt.
Biocycle BCYCDK, Vol. 30, No. 6, p 72-77, June 1989. 1 fig.

Descriptors: *Waste management, *Regional planning, *Waste disposal, *Wastewater treatment, *Sludge disposal, *Composting, *Regional analysis, Wastewater solids, Water reuse, Vermont, Septic sludge, Industrial wastes, Land disposal, Cost analysis, Sludge solids, Wastewater facilities, Operating policies, Market value, Site selection, Administrative avenues, Soil disposal fields.

The Vermont Department of Environmental Conservation instituted a number of studies to evaluate sludge management on a regional basis. Composting was chosen as an additional beneficial reuse technology. The state has been divided into five regional study areas: (1) Connecticut River Valley, (2) Rutland area, (3) Central Vermont, (4) Chittenden County, and (5) Northeast Kingdom. The Connecticut River Valley area, with a total of 45 towns, was the first study initiated. The relationship between wastewater solids, septage solids and miscellaneous, industrial and commercial solids is shown by the initial and design year total solids generation for the Connecticut River Valley study area. All of the studies underway are evaluating sludge composting and land application at agronomic rates. Following the review of present worth cost analysis of the composting alternatives, the State of Vermont requested that the study be expanded to include land application. Two reactor,

and one non-reactor (aerated static pile, aerated windrow, windrow) composting technologies are being evaluated for use in the Connecticut River Valley. The preliminary design application alternatives incorporates sludge application rates and the agricultural land requirements. Centralized and decentralized approaches have been developed to handle liquid sludge wastes. Both approaches offer viable and workable solutions to the handling and processing of liquid sludge and septage. The major finding in the Connecticut River Valley study is that the present worth cost of the composting alternatives is essentially equal to the present worth cost of land application at agronomic rates if purchase of the land is included. Present worth cost for composting and land application averaged $27.5 million and $29.5 million, respectively. These costs will be further defined when potential sites are identified. With the present worth cost being equal, the driving force within the Connecticut River Valley for the management of sludge and septage will be implementability. (Miller-PTT)
W89-12733

SLURRY COMPOSTING OPTIONS.
Cordoba Univ. (Spain). Dept. of Agricultural Chemistry and Pedology.
For primary bibliographic entry see Field 5D.
W89-12767

SCIENTIFIC ANALYSIS OF PROPOSED SLUDGE RULE.
Agricultural Research Service, Beltsville, MD.
R. L. Chaney.
Biocycle BCYCDK, Vol. 30, No. 7, pp. 80-85, July 1989. 0 fig, 4 tab, 2 ref.

Descriptors: *Administrative regulations, *Sludge utilization, *Sludge disposal, *Standards, Land disposal, Hydrogen ion concentration, Toxicity, Heavy metals, Polychlorinated biphenyls, Risk assessment, Quality control.

As part of the review process of the Part 503 Proposed Standards for Sewage Sludge Disposal, the U.S. Environmental Protection Agency asked a committee of experts to do a formalized review of the land-related disposal practices covered in the regulation. This included land application, distribution and marketing, monofilling and surface disposal. The peer review committee found significant failings in the background scientific data used to develop the specific limitations. Absence of pH control, no sludge quality limits, failure to rely on field demonstrations of no toxic effect, unfounded calculation of slopes, use of toxicological data relevant only to drinking water, presumption that sludge is mixed in with soil, low calculation for childhood soil ingestion, and unrealistic application and nitrogen limits all posed problems. The peer review group also found errors in EPA calculations for copper, zinc, and PCBs. The peer review group's evaluation of the proposed Part 503 rule resulted in revised cumulative application limits that would allow for continued beneficial use of a median quality sludge at rates of at least 500 to 1000 metric tons/hectare. They concluded that utilization of median quality sludges comprise no risk to humans, livestock, wildlife, or the environment when applied as part of agricultural production practices, revegetation programs, etc. (Mertz-PTT)
W89-12768

MINIMISATION OF MICROBIOLOGICAL HAZARDS ASSOCIATED WITH LATRINE WASTES.
Robens Inst. of Industrial and Environmental Health and Safety, Guildford (England).
For primary bibliographic entry see Field 5D.
W89-12783

AEROSOLIZED ENTERIC BACTERIA AND VIRUSES GENERATED BY SPRAY IRRIGATION OF WASTEWATER.
Hebrew Univ. of Jerusalem (Israel). Graduate School of Applie Science and Technology.
H. I. Shuval, N. Guttman-Bass, J. Applebaum, and B. Fattal.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 131-135, July 19, 1989. 3 fig, 4 ref.

Descriptors: *Wastewater irrigation, *Spray irrigation, *Sprinkler irrigation, *Enteric bacteria, *Viruses, *Public health, Aerosols, Israel.

Field investigations on the dispersion of aerosolized enteric bacteria and viruses generated by wastewater sprinkler irrigation were carried out at agricultural communities in Israel. A total of 154 air samples were taken in the vicinity of wastewater irrigated fields by two different methods: (1) Anderson multistage impactor air samplers, and (2) High Volume Cyclone Scrubbers (HVCS). All night samples at 730 m were positive for bacterial indicator organisms. 10% of the air samples by HVCS were presumptively positive for enteric viruses including 3 out of 24 samples taken at 730 m downwind from the wastewater sprinkler fields. In 31% of the virus positive samples, none of the 3 bacterial indicators were detected. These findings suggest that aerosolized enteric viruses are more resistant to hostile environmental factors than the airborne bacterial indicator organisms. (Author's abstract)
W89-12798

MATRIC WATER POTENTIAL AS AN ECOLOGICAL DETERMINANT IN COMPOST, A SUBSTRATE DENSE SYSTEM.
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
F. C. Miller.
Microbial Ecology MCBEBU, Vol. 18, No. 1, p 59-71, 1989. 2 fig, 58 ref.

Descriptors: *Waste disposal, *Composting, *Sludge digestion, *Biodegradation, Waste treatment, Degradation, Oxygen, Anaerobic digestion, Digestion.

An investigation of the relationship of matric water potential (water held by physical attraction) to gravimetric water content was carried out in a laboratory composting system using a sewage sludge and wood chip substrate. A curve was developed to describe this relationship. It applies to moisture contents of 23% to 64%. It was proposed that composting fails under drier conditions because bacteria progressively fail to physically colonize the substrate. Better conditions for composting under low moisture conditions are produced by agitation and introduction of inoculum in mixed systems, and by thorough initial colonization in nonmixed systems. (Cassar-PTT)
W89-12965

CIRCULAR CONVECTION DURING SUBSURFACE INJECTION OF LIQUID WASTE, ST. PETERSBURG, FLORIDA.
Geological Survey, Tampa, FL.
J. J. Hickey.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1481-1494, July 1989. 19 fig, 24 ref.

Descriptors: *Underground waste disposal, *Path of pollutants, *Dolomite, *Liquid wastes, *Saline water, *Groundwater pollution, *Model studies, *Injection wells, Porosity, Chlorides, Florida, Convection, Observation wells, Density currents.

Injection of liquid waste into a highly transmissive, saltwater-bearing, fractured dolomite underlying the city of St. Petersburg, Florida, provided an opportunity to study density-dependent flow associated with two miscible and density-different liquids. The injection zone was 98 m thick with a radial hydraulic conductivity of 762 m/d and a vertical hydraulic conductivity of 152 m/d. Mean chloride concentrations of the injectant during two tests of 91 and 366 days duration were 180 and 170 mg/L, respectively, whereas chloride concentration of native salt water ranged from 19,000 to 20,000 mg/L. During the 366-day test, chloride concentration in water from a well open to the upper part of the injection zone 233 m from the injection well approximately stabilized at about 4000 mg/L. Relatively constant chloride concentrations in water from this observation well at a level significantly greater than the injectant concentration suggested the hypothesis that circular convection with saltwater flow added chloride ions to the injection zone flow sampled at the observation well. Mass transport model simulations were used to provide information about the velocity field during injection, after determining that the fractured injection zone could be treated as an equivalent porous medium with a single porosity. The mass transport model was calibrated using the 91-day test data from two observation wells 223 m from the injection well and was then run without parameter changes to simulate the 366-day test. Mass fractions of injectant computed for four observation wells during the 366-day test compared favorably with observed mass fractions. Comparisons between model-computed mass fraction and velocity fields in a radial section showed circular convection, with salt water flowing toward the injection well in the lower part of the injection zone. The salt water then mixed with the injectant, and the mixture flowed away from the injection well in the upper part of the injection zone. On the basis of the model results and the assumed reasonableness of treating the injection zones as an equivalent porous medium with a single porosity, the hypothesis of circular convection with saltwater flow during subsurface injection of liquid waste into a highly transmissive saltwater-bearing fractured dolomite was judged acceptable. (Author's abstract)
W89-12975

ANALYSIS OF NATURAL GROUNDWATER LEVEL VARIATIONS FOR HYDROGEOLOGIC CONCEPTUALIZATION, HANFORD SITE, WASHINGTON.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
R. H. Nevulis, D. R. Davis, and S. Sorooshian.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1519-1529, July 1989. 10 fig, 5 tab, 24 ref. DOE contract DE-AM06-76-RL02225.

Descriptors: *Model studies, *Groundwater level, *Hazardous materials, *Radioactive waste disposal, *Statistical analysis, *Path of pollutants, Columbia River, Surface-groundwater relations, Geohydrology, Hydraulic conductivity, Drawdown, Aquifers, Confined aquifers.

A study was conducted to analyze a groundwater level time series to obtain details for a conceptual hydrogeologic model at a time when conventional hydraulic stress testing was not feasible due to regulatory considerations. The study area is located in south central Washington in the Pasco Basin which was a candidate site for underground disposal of high-level radioactive nuclear wastes. Advantages of such passive methods of analysis may include relative simplicity, low costs, and avoidance of disturbances typically associated with stress testing of aquifers. Through this approach, natural and incidental man-made groundwater level variations, most of which are quite small, may be examined by statistical and analytical methods in conjunction with hydrogeologic models to draw inferences on the hydrogeology. Vertical connectivity of the hydrostratigraphic units was also examined by analyzing groundwater level time series of five units at three piezometer nests. The stage variation in the Columbia River proved sufficient for the study of a number of confined basalt aquifers in the Pasco Basin. It is concluded that a combination of statistical/analytical approaches used in a complementary fashion can provide useful information about the hydrogeology of a given area. A meaningful analysis requires that there is (1) a source of influence on the groundwater levels, (2) a response to that influence, (3) a sufficiently long data record, and (4) measurement and analytical techniques which allow the detection and identification of the influence and response. (Peters-PTT)
W89-12979

GROUNDWATER TRAVEL TIME UNCERTAINTY ANALYSIS USING SENSITIVITY DERIVATIVES.
INTERA Technologies, Inc., Austin, TX.
For primary bibliographic entry see Field 5B.

W89-12982

OUT OF SIGHT IS NOT OUT OF MIND: PUBLIC OPPOSITION TO OCEAN INCINERATION.
Alabama Agricultural Experiment Station, Auburn.
C. Bailey, and C. E. Faupel.
Coastal Management CZMJBF, Vol. 17, No. 2, p 89-102, 1989. 1 tab, 35 ref.

Descriptors: *Waste disposal, *Ocean dumping, *Hazardous materials, *Incineration, Liquid wastes, Public opinion.

During the early 1980s, ocean incineration emerged as one of the hottest issues in the field of hazardous waste management. Ocean incineration involves the thermal destruction of liquid hazardous wastes on specially designed ships and was promoted by the Environmental Protection Agency and powerful industry groups as part of the solution to liquid hazardous waste disposal. Attempts to adopt ocean incineration led to heated debate and apparent defeat of efforts to introduce this technology. The arguments advanced by proponents are examined. Success of environmental groups opposed to ocean incineration is explained with reference to technical, environmental, sociopolitical, and legal factors. Ocean incineration, promoted as a solution to 'not-in-my-backyard' opponents, instead ran afoul of region-wide opposition by coastal residents for whom the sea is a common backyard. (Author's abstract)
W89-13046

COMPUTERIZED DEGREE OF HAZARD ASSESSMENT FOR EVALUATION OF WASTES: AN INNOVATIVE AID TO THE MANAGEMENT OF RESIDUALS.
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
M. J. Plewa, R. A. Minear, D. Ades-McInerney, D. L. Thomas, and G. D. Miller.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 821-831, 1989. 9 fig, 2 tab, 16 ref.

Descriptors: *Risk assessment, *Waste characteristics, *Waste management, *Waste disposal, *Computers, *Hazardous materials, *Industrial wastes, Illinois, Waste streams, Resource Conservation Recovery Act, Regulations.

To determine if a degree-of-hazard analysis could be implemented, a statistically representative sample of the Resource Conservation Recovery Act (RCRA) Special Wastes and the non-RCRA Special Wastes manifested for disposal in 1984 in Illinois were analyzed. The term 'Special Waste' includes all federally-regulated hazardous wastes as well as industrial process wastes as defined by the State of Illinois (non-RCRA wastes). A criticism of the present Illinois regulatory system is that all Special Wastes have similar requirements for applications that allow their transport and disposal. The current system does not address the different environmental and health risks posed by these waste streams. A degree of hazard evaluation of Illinois Special Waste streams was an appropriate method to determine the impact of these wastes upon the public health and environment. To conduct a degree of hazard evaluation of Special Waste streams, it is necessary to have quantitative data of a high quality. The degree of hazard approach permits a distinction among Special Waste streams based on an estimate of hazard based on scientific evidence. For poorly defined mixtures, a need for a set of toxicity assessment tests is clear. Such tests would need to be rapid and within reasonable economic costs. Such a hazard evaluation could be conducted in a consistently fair manner with a high degree of accuracy. (Author's abstract)
W89-13059

CHEMICAL CONTROLS ON THE FATE OF MERCURY AND LEAD CODISPOSED WITH MUNICIPAL SOLID WASTE.
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
J. P. Gould, F. G. Pohland, and W. H. Cross.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 833-843, 1989. 12 fig, 5 tab, 6 ref. EPA Cooperative Agreement no. CR 812158.

Descriptors: *Waste disposal, *Path of pollutants, *Fate of pollutants, *Mercury, *Lead, *Solid wastes, *Municipal wastes, Toxicity, Lysimeters, Chlorides, Sulfides, Sulfates.

Mercury and lead were among several toxic metals codisposed in test lysimeters with municipal solid waste. Results of analysis of leachate from these landfills during the acid phase of landfill operation have indicated that control of mercury in these systems is a consequence of reduction of divalent mercury to neutral mercury metal. This process was found to occur whether sulfide was present or not. Dissolved mercury in these leachates will exist virtually entirely as chloride complexes. Control of lead solubility was dependent on the presence or absence of sulfide. In the presence of sulfide, lead would precipitate as the sulfide while in its absence, the controlling solid was the sulfate. Soluble lead speciation involved significant fractions of both chloride and sulfate complexes. While sulfide has not been detected directly in these systems, levels necessary to control lead solubility were so low as to be undetectable by available methodology; its involvement cannot be precluded. Since some circumstantial evidence supportive of sulfate control has been obtained, the complete elucidation of chemical control mechanisms in these systems is not possible. (Author's abstract)
W89-13060

HAZARD ASSESSMENT OF WASTEWATER DISCHARGES - A CONFLUENCE OF BIOLOGICAL AND PHYSICAL PARAMETERS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
H. B. Pols.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 869-873, 1989. 4 tab, 2 ref.

Descriptors: *Risk assessment, *Wastewater analysis, *Wastewater disposal, *Wastewater treatment, Physical properties, Biological properties, Environmental hazards, Toxicity, Mutagenicity, Testing procedures, Waterfleas, Structure-activity relationships, Sample preparation, Water quality standards.

A criteria system is developed for assessing the environmental hazards associated with waste water discharges. Previously, only a relative criteria system was available. Since a publicly accepted waste water discharge like those from sewage treatment plants showed hardly any toxic effects and no evidence of mutagenicity, waste water from other sources may be judged in terms of as good, or more hazardous, than this reference effluent. It is concluded that a combination of the Microtox test and the Ames Salmonella/Microsome test are satisfactory for a preliminary judgement. For sake of security, a toxicity test with water fleas is advisable. The reverse phase liquid chromatography (RPLC) techniques proved to be effective in identifying compounds with high log P oct values. However, this method still needs to be optimized with regard to the preparation of samples and the detection procedures used. It was not possible to establish a link between the results of the RPLC analyses and the chronic toxicity investigation because of the small number of results. (Miller-PTT)
W89-13063

EVALUATION OF COMPOSTED SEWAGE SLUDGE/STRAW MIXTURE FOR HORTICULTURAL UTILIZATION.
Wye Coll., Ashford (England). Dept. of Biochemistry and Biological Sciences.
J. M. Lopez-Real, E. Witter, F. N. Midmer, and B. A. O. Hewett.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 889-897, 1989. 9 tab, 10 ref.

Descriptors: *Soil amendments, *Sludge utilization, *Waste disposal, *Activated sludge, *Composting, *Horticulture, Wastewater treatment, Straw, Fertilizers, Growth media.

Collaborative research between Southern Water and Wye College, University of London, has led to the development of a static aerated pile composting process for the treatment of dewatered activated sludge cake/straw mixtures. The process reduces bulk volume of the sludge producing an environmentally acceptable, stabilized, and odor-free and pathogen-free product. Characteristics of the compost make it a suitable general purpose medium for container grown plants, providing the salt concentration is reduced by washing the compost prior to planting. Compared with peat, the compost has a higher bulk density, a lower water-holding capacity, a lower cation exchange capacity, a higher content of soluble salts, and a higher content of plant nutrients. A compost mixture was successfully developed in the growing trials containing equal quantities of compost, Sphagnum peat, adn horticultural vermiculite. The compost has been used successfully to grow a wide range of plants. Plants grown in mixtures based on the compost were, in general, similar to those grown in peat-based growing media. The compost is a valuable soil conditioner and slow release fertilizer. (Author's abstract)
W89-13065

EFFECTS OF VARIOUS SEWAGE SLUDGE TREATMENT PROCESSES ON THE SURVIVAL OF POTATO CYST-NEMATODES (GLOBODERA SPP.) AND THE IMPLICATIONS FOR DISPOSAL.
Edinburgh School of Agriculture (Scotland).
For primary bibliographic entry see Field 5D.
W89-13067

SLUDGE LIQUEFACTION BY CONVERSION TO FUELS.
Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
N. Millot, A. Huyard, G. M. Faup, and J. P. Michel.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 917-923, 1989. 5 fig, 3 tab, 4 ref.

Descriptors: *Waste recovery, *Sludge utilization, *Synthetic fuels, *Waste disposal, *Wastewater treatment, *Sludge, *Liquefaction, Organic matter, Fuel, Conversion, Sludge disposal, Oil, Solvents, Aromatic compounds, Incineration, Economic aspects, Pilot plants, Economic feasibility.

Wastewater treatment plants involve sludge production, the disposal of which may pose some problems. These problems may be solved by conversion of sludge organic matter into high calorific value products. This technology not only eliminates sludge disposal problems but also generates fuel energy in the form of oil. A sludge liquefaction process at 200 to 300 C, at atmospheric pressure and using a solvent, has been developed. The results from batch and semi-continuous experiments, using bitumen or various aromatic solvents, are presented. Under optimal liquefaction conditions, 40 to 60% of the organic matter in the sludge was recovered and an incinerable oil with a gross calorific value of 8500 kcal/g was produced. The liquefaction of sludge can be compared to incineration processes. The combustion of the oil and of the liquefaction residue gives a product which is comparable to that obtained from sludge incineration. The main advantage could be a significant reduction of calorific leakage. Before economic comparison between the two processes can be made, certain experimental conditions must be specified. Sludges with less than 95% dryness must be used and the recovery rate during continuous processing remains to be determined. Building of a test pilot plant will enable the determination of the economic viability of the process described compared to incineration and other liquefaction processes. (Miller-PTT)
W89-13068

SEWAGE SLUDGE MELTING PROCESS BY COKE-BED FURNACE: SYSTEM DEVELOPMENT AND APPLICATION.
Kyoto Univ. (Japan). Dept. of Environmental and Sanitary Engineering.

N. Takeda, M. Hiraoka, S. Sakai, K. Kitai, and T. Tsunemi.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 925-935, 1989. 6 fig, 6 tab, 7 ref.

Descriptors: *Sludge disposal, *Waste recovery, *Wastewater treatment, *Sludge, *Melting, Steam, Furnaces, Coke-bed furnaces, Electric power production, Slag, Construction materials, Wastewater facilities, Sludge utilization, Japan.

The outline of the course of the development of the sewage sludge melting process using a coke-bed, the operating results of the commercial plant and some applications of the slag are described. At present, the commercial plant is working steadily at the Chuo Sewage Treatment Plant. As the process generates more steam than required for the plant operation, the heat efficiency will be improved if excess steam can be used outside of the plant. For this reason, electric power generation is planned at the plant for large scale treatment. The first step has been taken toward discovering highly effective applications. The integrated processing and utilization of sewage sludge as a construction material has been proposed and actually undertaken in Japan as the Sewage Sludge Processing Work Project for Large Area (Ace Plan). The melting process by coke bed furnace was adopted for two areas: (1) Osaka North-east Area (1st term work = 2 units of 50 tons-WS/day) and (2) Hyogo West Area (1st term work = 2 units of 200 tons-WS/day). Both of these are currently under operation. The melting furnace in Hyogo West Area will be the largest in Japan and includes electric power generating units as well. (Miller-PTT)
W89-13069

DILUTION AND TRANSPORT PREDICTIONS FOR OCEAN OUTFALLS.
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-13073

OPTIMIZATION STUDY OF THE PLANNING OF WATER POLLUTION CONTROL FOR MAJIAGOU STREAM IN HARBIN, CHINA.
Harbin Architectural and Civil Engineering Inst. (China). Dept. of Environmental Engineering.
Y. Gong, Q. Peishi, W. Baozhen, and S. Jun.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 995-1002, 1989. 6 fig, 2 ref.

Descriptors: *Optimum development plans, *Management planning, *Stream pollution, *China, *Water pollution control, Waste disposal, Wastewater treatment, Sewer systems, Planning, Cost-benefit analysis.

A study of the optimization planning of water pollution control for Majiagou Stream (Harbin, China) was carried out. Four water pollution control options were considered. The option regarded as most feasible, both technically and economically, involved the construction and operation of a wastewater treatment works with a capacity of 150,000 cu m/day on the upper reach of the stream. The effluent would be discharged into the upper reach of Majiagou Stream and would be used a water source for the stream, while an interceptor sewer was to be constructed on the lower reach of the stream to collect wastewaters in the lower reach basin and transport them to a centralized wastewater treatment plant. An optimization study of the relationship between the sewerage interceptor and the sewage treatment plant on the upper each was conducted. A comprehensive water pollution control plan, including the sewerage system, sewage treatment plant, and the use of treated wastewater as a water source for Majiagou Stream, was considered as a systematic problem in which many factors were taken into account. Cost-benefit analysis was carried out for both the sewage treatment plant and the interceptors by means of empirical regression equations and diagrams in which various curves showed the relationships between the important factors. (Author's abstract)
W89-13075

CASE STUDIES IN ORGANIC CONTAMINANT HYDROGEOLOGY.
Waste Management, Inc., Oak Brook, IL. Environmental Management Dept.
For primary bibliographic entry see Field 5B.
W89-13112

GEOCHEMISTRY OF SEDIMENTS IN THE BACK BAY AND YELLOWKNIFE BAY OF THE GREAT SLAVE LAKE.
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W89-13113

APPROACH TO THE FIELD STUDY OF HYDRAULIC GRADIENTS IN VARIABLE-SALINITY GROUND WATER.
Geological Survey, Tampa, FL.
For primary bibliographic entry see Field 2F.
W89-13168

LIME SLUDGE STABILIZATION OF SAND FOR CAPPING SANITARY LANDFILLS.
Kent State Univ., OH. Dept. of Geology.
A. Shakoor, and M. L. Schmidt.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 26, No. 2, p 227-239, 1989. 11 fig, 8 tab, 29 ref.

Descriptors: *Sludge disposal, *Landfills, *Lime, *Soil stabilization, Sand, Permeability, Slope stabilization, Sludge utilization.

Absence of adequate quantities of suitable capping material, such as clay, is a major problem at many landfill sites. A study was undertaken to develop alternative capping materials by stabilizing river sand with sludge additives. Different percentages of sewage sludge produced by anaerobic digestive systems and lime sludge produced by water clarifier systems were blended with river sand and the mixtures evaluated for their suitability as capping materials. An effective capping material, when compacted properly, should maximize density, reduce permeability, and maintain stability with respect to slope failure and volume changes. Results from this evaluation procedure suggest that sewage sludge is not effective in stabilizing sand for capping purposes. The addition of sewage sludge decreased maximum dry density from 102 lbs/cu ft for pure sand to 76.5 lbs/cu ft for the 40% mixture, whereas the permeability remained in the .0001 cm/sec range. Lime sludge effectively stabilized sand and can be used to produce a feasible capping material. With the addition of lime sludge, the maximum dry density increased from 105.6 lbs/cu ft for pure sand to 108.0 lbs/cu ft for the 10% mixture, and then decreased to 99.6 lbs/cu ft for the 50% mixture. The permeability decreased from an initial value of .00084 cm/sec for 0% sludge content to a low of .000001 cm/sec at 40% sludge content. On the basis of these results, the 20% lime sludge mix is considered to provide the best compromise between high density and low permeability in a compacted state. The 20% mix is also expected to be stable with respect to volume changes and slope failure as indicated by durability testing, shear strength parameters, and stability analysis. (Author's abstract)
W89-13196

HAZARDOUS WASTE SITE MANAGEMENT: WATER QUALITY ISSUES.
Report on a Colloquium Sponsored by the Water Science and Technology Board, February 19-20, 1987. National Academy Press, Washington, DC. Colloquium 3 of a Series. 1988. 212p.

Descriptors: *Water pollution control, *Conferences, *Environmental policy, *Water quality, *Waste dumps, *Waste management, *Hazardous materials, Toxins, Geohydrology, Engineering, Regulations, Legislation, Cleanup, Standards, Legal aspects, Risk assessment, Administrative agencies, Public policy.

This volume contains the report from the Water Science and Technology Board's third colloquium, entitled 'Hazardous Waste Site Management: Water Quality Issues,' held on February 19-20, 1987. This conference addressed the emerging scientific, engineering, and institutional issues associated with setting cleanup levels at hazardous waste sites, a major public policy question that is often articulated as 'How clean is clean'. These issues have important implications for both the health risks of the american population and the cost of remediation at the diverse sites currently being evaluated to determine the extent and nature of contamination. As a result, the setting of target cleanup levels for these sites is quite controversial. Nine papers were presented by experts affiliated with federal and state regulatory agencies, environmental and citizens groups, and industries that generate, store, or dispose of hazardous waste. The presenters included scientists and regulators involved in setting cleanup levels as well as those affected by the regulations. Provocateurs were selected to stimulate debate and discussion after the authors presented highlights from their papers. The attendees participated in workshops, evaluating the roles of hydrogeology, engineering, and risk assessment/toxicology. Alternative regulatory strategies for setting cleanup levels at hazardous waste sites were discussed. The report has two major sections: an overview and the background papers by individual authors. The colloquium's chairman prepared the overview based on a review of the background papers and a consideration of the presentations and workshop discussions. (See W89-13199 thru W89-13207) (Hammond-PTT)
W89-13198

SETTING ENVIRONMENTAL STANDARDS FOR HAZARDOUS WASTE SITES: A BREAK FROM THE PAST OR A CONTINUUM.
Dowd (R.M.) and Co., Washington, DC.
R. M. Dowd.
IN: Hazardous Waste Site Management: Water Quality Issues. National Academy Press. Washington, DC. 1988. p 13-21.

Descriptors: *Waste dumps, *Hazardous materials, *Waste management, *Regulations, *Legislation, *Environmental policy, *Standards, *Pesticides, *Water pollution control, Legal aspects, Public policy, Water policy, History, Federal jurisdiction, Contamination, Pollutants, Fate of pollutants, Toxins, Carcinogens, Air pollution, Water pollution, Reviews.

The history of standard setting and regulatory programs used in hazardous waste site management is reviewed. Starting in the 1970's with the passage of the National Environmental Policy and the Clean Air acts, the development of the concepts and legislation relating to threshold levels and acceptable margins of safety for conventional air and water pollutants are summarized. This first wave of environmental regulation attempted to set a number based on a threshold and required environmental managers to control the stack or outfall emissions to meet the numbers. Other environmental legislation followed a similar approach. For example, the federal pesticide statute that made the Environmental Protection Agency, rather than the U.S. Department of Agriculture, responsible for setting acceptable limits on pesticide residues in food incorporated this threshold concept under the term 'tolerance.' The nascent cancer policy published by the Environmental Protection Agency in 1975 was a preview of coming attempts to quantify, weigh, and balance; a process that evolved into the 'postthreshold concept' age of regulation. The focus on toxins different in nature, concentration, and behavior from the conventional bulk pollutants resulted from advances in analytical chemistry and improvements in the sensitivity of the methods. The shift also resulted in changes in biological experimentation: the number of long term studies on mammals to determine if substances are carcinogenic has burgeoned since the early 1970's. The Toxic Substances Control Act in 1976 was the first important legislation reflecting this change. Since 1980, public concerns over hazardous wastes have moved to an almost exclusive preoccupation with the presence of toxic chemicals and the possibility that trace concentrations cause long-term chronic health damage. There also has been an attempt to

deal routinely with multiple chemicals, in multiple media, through multiple routes of transport and exposure. In areas like hazardous wastes, there are many incentives to establishing worst-case conditions, however unrealistic, and regulating against them. But there is never justification for not holding to the principle of using the real world as the ultimate measure for solving real problems. (See also W89-13198) (Hammond-PTT)
W89-13199

ESTABLISHING AND MEETING GROUND WATER PROTECTION GOALS IN THE SUPERFUND PROGRAM.
Environmental Protection Agency, Washington, DC.
E. F. Barth, W. Hanson, and E. A. Shaw.
IN: Hazardous Waste Site Management: Water Quality Issues. National Academy Press. Washington, DC. 1988. p 22-30, 4 fig, 5 ref.

Descriptors: *Cleanup operations, *Water quality standards, *Water quality control, *Water pollution control, *Regulations, *Water law, *Environmental policy, *Legislation, *Superfund, Legal aspects, Contamination, Public policy, Remedies, Economic aspects, Federal jurisdiction, Groundwater management, Standards, Hazardous materials, Institutional constraints, Carcinogens, Risk assessment, Public health.

Under the National Contingency Plan, remedial actions at Superfund sites shall meet or exceed all applicable or relevant and appropriate federal requirements and consider other pertinent federal criteria, advisories, and guidances and state standards. Federal requirements that may be applicable are included in the Resource Conservation and Recovery Act Subpart F regulations. Determinations of groundwater protection levels may be based on a site-specific risk assessment. The Safe Drinking Water and Clean Water acts resulted in the development of maximum concentration levels and goals, health advisories, and water quality criteria for the protection of public health. In addition, the Environmental Protection Agency's groundwater protection strategy specifies that groundwater should be protected differentially based on characteristics of vulnerability, use, and value. Source control measures should facilitate the achievement of long-term remediation objectives and goals. The Environmental Protection Agency's guidance document for feasibility studies under the Comprehensive Environmental Response, Compensation, and Liability Act calls for the development, screening, and detailed evaluation of alternatives proposed for remedial actions. The performance goal of each groundwater alternative should be expressed in terms of a cleanup concentration and a time period for the restoration for all locations in the area of attainment. Factors that influence the decision as to which remedial action alternative to select and implement for carcinogens and noncarcinogens include health risks, feasibility of providing alternative water supplies, current use of groundwater, potential needs, institutional controls and the ability to monitor. Other factors may include limiting the extent of the contamination, its impact on environmental receptors, the technical practicability of alternative implementation, and the alternative's cost. The remedial process must be flexible, allowing changes in the remedy based on the performance of several years of operation. (See also W89-13198) (Hammond-PTT)
W89-13200

CALIFORNIA SITE MITIGATION DECISION TREE PROCESS: SOLVING THE 'HOW CLEAN SHOULD CLEAN BE' DILEMMA.
California Dept. of Health Services, Sacramento.
D. J. Leu, and P. W. Hadley.
IN: Hazardous Waste Site Management: Water Quality Issues. National Academy Press. Washington, DC. 1988. p 67-95, 1 tab, 13 fig, 4 ref.

Descriptors: *Waste dumps, *Water pollution prevention, *Management planning, *Decision making, *California, *Waste management, *Cleanup, *Standards, Data collectiona, Data processing, Fate of pollutants, Remedies, Groundwater pollution, State jurisdiction, Case studies, Arsenic, Project planning, Public health, Population exposure, Handbooks, Water quality standards.

The California Site Mitigation Decision Tree Manual has been created as a technical guidance document to assist project managers in making decisions that have a strong analytical basis and technical merit. The process was designed to be flexible in application. The decision-branching format allows quick identification of the pathways of exposure that must be characterized for each site. To facilitate a scientifically based decision process the decision tree incorporates a series of unique aspects. First, it requires a multimedia approach to site characterization and the establishment of cleanup criteria. Second, it identifies the specific parameters for which data must be collected. Third, it identifies the preferred data gathering, handling, and analytical techniques that should be used. Fourth, it establishes statewide, health-based criteria called applied action levels that are specific to particular substances, media, and biologic receptors. They define an exposure level in which no observed adverse effect would be found. Fifth, the decision tree process also allows the different cleanup levels to be set for a particular site, a capability that reflects the different degrees of effectiveness of various remedial action combinations. Using the process the project manager is in a position to select the final cleanup solution that best suits the condition of the particular site. Two case studies are presented. In the first case study an arsenic-contaminated site is used to illustrate how the decision tree process is used to set cleanup criteria quickly. In the second case study a site with groundwater contamination is used to demonstrate how various remedial actions are evaluated so that the best option is selected. (See also W89-13198) (Hammond-PTT)
W89-13202

ESTIMATING HEALTH RISKS AT HAZARDOUS WASTE SITES: DECISIONS AND CHOICES DESPITE UNCERTAINTY.
ENVIRON Corp., Washington, DC.
For primary bibliographic entry see Field 5G.
W89-13207

ADVANCES IN LABORATORY TESTING TO QUANTITATIVELY DESCRIBE SEDIMENT-WATER INTERACTIONS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W89-13255

EVALUATING BIOAVAILABILITY OF NEUTRAL ORGANIC CHEMICALS IN SEDIMENTS: A CONFINED DISPOSAL FACILITY CASE STUDY.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W89-13257

DREDGED-MATERIAL DISPOSAL PLANNING PROGRAMS.
D. T. Ford.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 282-288, 3 fig, 7 ref.

Descriptors: *Spoil banks, *Delaware River, *Planning, *Dredging, *Waste management, *Waste disposal, Computer programs, Costs, Disposal sites, Long-term planning.

Efficient long-term dredged material management requires long-term planning. Three computer programs are available to assist with this planning. The programs are: (1) an operation optimization program; (2) a geographic information system (GIS); and (3) a capacity-expansion program. The operation optimization program determines the least-costly annual allocation of material to available disposal sites. The GIS identifies potential new disposal sites. The capacity expansion program finds the least costly site acquisition sequence. The programs were used in the Delaware River dredging disposal study. (See also W89-13231) (Lantz-PTT)
W89-13259

RELATIONSHIP BETWEEN SUBSURFACE GEOHYDROLOGIC INVESTIGATION AND SITING OF UPLAND DISPOSAL SITES/ DEWATERING SITES FOR USE OF DREDGED MATERIAL AS SANITARY LANDFILL COVER.
Army Engineer District, New York.
C. A. Coch, and J. F. Tavolaro.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 289-311, 3 fig, 2 tab, 13 ref.

Descriptors: *Water pollution prevention, *Geohydrology, *Waste disposal, *Dredging, *Landfills, Disposal sites, New Jersey, New York, Water quality, Sediment characteristics, Leachates, Groundwater quality.

Preliminary site screening, including geohydrologic investigations, is one of the key factors in determining the feasibility of regional upland disposal/dewatering areas for use of dredged material as sanitary landfill cover. This is especially true in a highly urbanized area such as the New York/ New Jersey Harbor area where waterfront land is at a premium, and there is a potential for groundwater contamination due to prior uses of sites or adjacent areas. Hydrologic and geologic surveys that were conducted as part of the feasibility studies for upland disposal/use of dredged material as sanitary landfill cover proved valuable in identifying sites for further consideration. Site N30 (Fresh Kill, NY) is currently being used for a pilot program for use of dredged material as landfill cover by the New York City Department of Sanitation. Two other potential sites remain: N-37 (Elizabeth, NJ) and N-61 (Belford, NJ), which could be considered for either regional upland disposal or regional dewatering sites. The result of the investigations was to design the potential upland/dewatering sites so they would have minimal impact on groundwater and to maintain acceptable surface water standards. Studies show that each of the potential sites does not pose a contamination threat to underlying aquifers. The sites exhibit one or more of the following features: naturally occurring aquitards preventing downward percolation of leachate, existing high levels of salinity and total dissolved solids in surface water and underlying aquifers, and lack of drinking water supply from aquifers in the vicinity of the sites. Only on site N-61, where a semi-confining or discontinuous aquitard was found overlying an aquifer, was a recommendation made to line the upland/dewatering basins with an impervious liner. The fine-grained character of much of the dredged material also makes it highly suitable for cover material in preventing percolation of leachate in landfills. Because of the very fine grain size of typical dredged material, settling basins were recommended at the sites to reduce potential impacts to surface waters. Depending upon the characteristics of the specific dredged material to be disposed, control measurers such as polymer addition to decrease suspended sediments in the return flow could be implemented. (See also W89-13231) (Lantz-PTT)
W89-13260

RECENT DEVELOPMENTS IN ESTIMATING POLYCHLORINATED BIPHENYL (PCB) LOSSES FROM CONFINED DISPOSAL FACILITIES.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5B.
W89-13261

EROSION AND RESUSPENSION EFFECTS OF HURRICANE GLORIA AT LONG ISLAND SOUND DREDGED MATERIAL DISPOSAL SITES.
Corps of Engineers, Waltham, MA. New England Div.
For primary bibliographic entry see Field 5B.

W89-13262

USE OF SPOT HRV DATA IN THE CORPS OF ENGINEERS DREDGING PROGRAM.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 7B.
W89-13263

TIERED APPROACH FOR EVALUATING SEDIMENT QUALITY AT MULTIPLE COASTAL AND RIVERINE DREDGING PROJECTS.
Army Engineer District, Portland, OR. Advance Planning Branch.
For primary bibliographic entry see Field 7A.
W89-13264

SURFACE AND GROUNDWATER MONITORING AT TIMES BEACH CONFINED DISPOSAL FACILITY, BUFFALO, NEW YORK.
Corps of Engineers, Buffalo, NY. Water Quality Section.
For primary bibliographic entry see Field 5B.
W89-13265

THIN-LAYER DISPOSAL: A MODIFICATION OF CONVENTIONAL OVERBOARD DISPOSAL OF DREDGED MATERIAL.
Corps of Engineers, Mobile, AL. Coastal Environment Section.
R. D. Nester.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 390-397, 1 ref.

Descriptors: *Spoil banks, *Estuaries, *Waste disposal, *Thin-layer disposal, *Dredging, Water quality, Fisheries, Fowl River, Alabama, Mobile Bay, Wetlands, Water pollution effects.

In an effort to reduce impacts associated with the open water disposal of dredged material, a test was initiated to determine the feasibility and impact of thin-layer open water disposal. The concept of thin-layer open water disposal suggests that the active spreading of dredged material in a 6-12 inch lift would reduce the short-term impact on bottom resources such that recovery of these affected resources would be faster. The test case for the thin-layer disposal was an existing Federally authorized navigation project known as the Fowl River navigation project. The project provides an 8-ft by 100-ft channel for commercial fishing and recreational boating interests and is a small coastal stream which meanders through extensive wetland areas along the western shore of Mobile Bay in Alabama. Based on the results of the bathymetric surveys and vertical sediment profiling, dredging material was disposed in the deeper portion of the disposal area and south fringe area. The depth of the material was observed to be 2 ft or greater in only 1% of the disposal area. The materials were detectable throughout all post-disposal sampling efforts including the 52-week sampling effort. There was evidence that the materials were slowly drifting in a southeasterly direction and were being reworked mainly by physical forces. Transient impact to water quality was observed during dredged materials disposal in terms of elevated total suspended solids. The impacts were localized to a small area around the dredge discharge during the disposal operation. A slight reduction in total macroinfauna abundance was observed following the dredged material disposal within the disposal area. However, this reduction was not verified statistically. The impact of the dredging operation on the utilization of the area by fishes was not statistically verified. Some fish species were extremely abundant in the disposal area during the 2 and 6 week post-disposal sampling efforts and some species present in the disposal area prior to disposal were not found at all. Changes in fish communities appeared to follow the usual temporal and seasonal trends observed in estuaries. No net decrease in the utilization of the study area by the fisheries resources was seen. (See also W89-13231) (Lantz-PTT)
W89-13266

MOBILE HARBOR, ALABAMA, DUMP SCOW OVERFLOW TEST: PRELIMINARY REPORT OF FINDINGS.
Corps of Engineers, Mobile, AL. Coastal Environment Section.
F. D. Imsand.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 398-409, 2 fig, 2 tab, 3 ref.

Descriptors: *Spoil banks, *Costs, *Mobile Bay, *Waste disposal, *Dredging, Sediments, Estuaries, Hydraulic dredging.

The Dredged Material Dump Scow Overflow Test in Mobile Bay investigated a possible way to lower dredging costs where hydraulic dredging in combination with dump scows might be used. The test was designed to determine if, through the use of a hydraulic dredge, dredging fine grained estuarine sediments with discharge into dump scows, it would be possible to increase the sediment content of the scows by continued dredging and discharge past the point of scow overflow. The test design also provided for an analysis of the environmental impacts associated with such overflow. Due to the naturally fluid characteristics of the fine grained maintenance material, there was little expectation that consolidation would occur in the scows past the point of overflow. It was decided to also include maintenance material tests and use the information collected as a frame of reference. None of the three maintenance material tests showed much gain in scow load when dredging past the point of overflow. The increase in scow draft due to overflowing for an average of 31 minutes averaged only 0.29 ft or about 2.4% of the average draft of the filled scows. The virgin material at the upper site was considerably more dense than the lower site and contained more sand. After three tests, all showing fairly similar characteristics, the field tests were concluded. The average time of scow overflow for the three virgin material tests at the upper site was 37 minutes. The average additional scow draft was 0.45 ft which equates to 3.2% of the average draft of the filled scows. Using the percentage change of the total scow draft, from the beginning to the end of overflow, as a tool to evaluate the effectiveness of the scow overflow technique in the bay shows that the maintenance material performed the poorest of any material tested. The virgin material in the lower bay had a better scow retention rate than the maintenance material but less than the upper bay virgin material. The average percentage changes of the total scow draft for the maintenance material and the lower and upper virgin material tests are 2.4, 2.8 and 3.2, respectively. Although the scow load curves for the virgin material tests were similar in nature, there was some variability between them. (See also W89-13231) (Lantz-PTT)
W89-13267

MANAGEMENT OF DREDGED MATERIAL DISPOSAL AREAS.
Army Engineer District, Charleston, SC.
I. B. Kyzer.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 410-413, 8 ref.

Descriptors: *Spoil banks, *Dredging, *Waste management, *Waste disposal, Charleston Harbor, Dewatering, Management planning, Wildlife habitats, Waste utilization.

In 1975, as the Dredged Material Research Program (DMRP), conducted by the US Army Waterways Experiment Station (WES), was nearing completion, the Charleston District began working with WES personnel and applying some of the techniques developed during the DMRP for managing dredged material disposal areas. After experimenting with several disposal areas and noting positive results, the District initiated a disposal area management program and established the following goals: (1) design and develop dredged material disposal areas that will contain all the shoal material safely and efficiently and that can be operated in such a manner that the effluent can be released without harming the environment and meet applicable standards; (2) densify the dredged material, and consolidate subsurface sediments such that the maximum amount of volume may be regained from the areas; (3) develop techniques which can be used to accelerate drying and dewatering of the dredged material; (4) develop and apply techniques which will reduce the mosquito breeding potential of the disposal areas; (5) create wildlife habitat within disposal areas during periods of inactivity; and (6) find off-site uses for the dewatered dredged material. Surveys indicate that millions of cubic yards of volume have been regained from the disposal areas in the Charleston District, thus extending their useful life. Had a management program not been initiated, many of the areas now used would have been abandoned for one reason or another. In general the dikes have been improved in terms of stability and detention time of the improved basins. Spillway structures, while still a problem, have been improved in terms of structural integrity and stability. However, no matter how successful a management program is, eventually the areas will be filled to a height that will render them unuseable. Unless some use is found for the material, remote upland sites or ocean disposal will be required in the future. (See also W89-13231) (Lantz-PTT)
W89-13268

NORTH CAROLINA SANITARY LANDFILLS: LEACHATE GENERATION, MANAGEMENT, AND WATER QUALITY IMPACTS.
North Carolina State Univ., Raleigh. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-13318

GEOLOGIC AND HYDROLOGIC DATA FOR THE RUSTLER FORMATION NEAR THE WASTE ISOLATION PILOT PLANT, SOUTHEASTERN NEW MEXICO.
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-13348

HYDROLOGICAL AND METEOROLOGICAL DATA FOR AN UNSATURATED ZONE STUDY NEAR THE RADIOACTIVE WASTE MANAGEMENT COMPLEX, IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO--1985-86.
Geological Survey, Idaho Falls, ID. Water Resources Div.
J. R. Pittman.

Descriptors: *Idaho, *Path of pollutants, *Aeration zone, *Recharge, *Waste disposal *Geohydrology, *Groundwater movement, *Radioactive wastes, *Soil water, Psychrometer, Meteorology, Idaho National Engineering Laboratory.

Radioactive waste has been buried at the RWMC (Radioactive Waste Management Complex) at the Idaho National Engineering Laboratory since 1952. In 1952, the U.S. Geological Survey and EG&G Idaho, Inc., in cooperation with the U.S. Department of Energy began a study of the geohydrology of the RWMC to provide a basis for estimating the extent of and the potential for migration of radionuclides in the unsaturated zone beneath the waste burial trenches and pits. The hydrologic properties of the unsaturated zone and amount of net recharge to the system must be determined to field-calibrate a mathematical model to predict the long-term migration of radionuclides in the unsaturated zone. Two test trenches were installed in the surficial sediment adjacent to disturbed soil. Hydrologic data collected during 1985 and 1986 included 30 measurements, taken every 12 hours, of soil temperature and soil-water potential at selected depths to about 6 m using thermocouple psychrometers; and 173 soil-moisture content measurement collected bimonthly with a neutron moisture depth gage. Meteorological data averaged every 6 hours included wind speed, wind direction, relative humidity, air temperature; solar radiation and precipitation were totalized over the 6 hour period. (USGS)
W89-13373

SUBSURFACE STORAGE OF LIQUIDS IN THE FLORIDAN AQUIFER SYSTEM IN SOUTH FLORIDA.
Geological Survey, Miami, FL. Water Resources Div.
F. W. Meyer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-477, 1989. 25p, 10 fig, 7 tab, 26 ref. Project FL-002.

Descriptors: *Injection wells, *Underground waste disposal, *Florida, *Underground storage, *Groundwater movement, *Floridan Aquifer, Geohydrology, Water quality.

The Floridan aquifer system in south Florida is composed chiefly of carbonate rocks that range in age from early Miocene to Paleocene. The top of the Floridan aquifer system generally occurs at depths ranging from 500 to 1,000 ft, and the average thickness is about 3,000 ft. It is divided into three general hydrogeologic units that include the Upper Floridan aquifer, the middle confining unit, and the Lower Floridan aquifer. Groundwater movement in the Upper Floridan aquifer is generally from the area of highest head in central Florida, eastward to the Straits of Florida, westward to the Gulf of Mexico, and, to a much lesser extent, southward. Injection of nontoxic liquid wastes into deep, saline parts of the Floridan aquifer system as a pollution-control measure began in 1943 with injection of oilfield brine in southwest Florida. Since then, the practice has quickly expanded, and many high capacity municipal and industrial injection wells are now in operation in southeast Florida. The principal use of the Floridan aquifer system in south Florida is for subsurface storage of liquid waste. The Boulder Zone of the lower Floridan aquifer is extensively used as a receptacle for injected treated municipal wastewater, oilfield brine, and, to a lesser extent, industrial wastewater. Pilot studies indicate a potential for cyclic storage of freshwater in the Upper Florida aquifer in south Florida. (USGS)
W89-13375

LOW-FLOW PROFILES OF THE COOSA RIVER AND TRIBUTARIES IN GEORGIA.
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-13385

HAZARDOUS WASTE MANAGEMENT FACILITY SITING IN GEORGIA.
Georgia Univ., Athens. Carl Vinson Inst. of Government.
J. Kundell, and E. R. Jordan.
Report, Public Policy Research Series, 1987. 22p, 14 ref, 2 append.

Descriptors: *Waste disposal, *Environmental policy, *Environmental protection, *Georgia, Hazardous materials, Waste management, Waste storage, Wastes.

Although it is known that the proper handling of hazardous waste is necessary and that new technologies are being developed to treat these wastes, identifying acceptable hazardous waste management sites is becoming increasingly difficult. Georgia, like other states, is faced with the tasks of siting a facility that is capable of properly treating hazardous wastes generated by its industries and safely disposing (or storing) the residual wastes. This study examines the knowledge gained from past efforts in Georgia, describing three major controversies regarding treatment and disposal sites. It also explains powers and duties of the Georgia Hazardous Waste Management Authority and provides procedures which may be important for successfully siting a facility in Georgia. (Allen-U.GA-Inst. Gov.)
W89-13394

COMPUTATION OF THREE-DIMENSIONAL ADVECTION-DOMINATED SOLUTE TRANSPORT IN SATURATED AQUIFERS.
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W89-13396

5F. Water Treatment and Quality Alteration

WATER MANAGEMENT AND RECREATIONAL VALUES: SOME REAL CASES IN VICTORIA, AUSTRALIA.
Victoria State Rivers and Water Supply Commission, Armadale (Australia).
For primary bibliographic entry see Field 3D.
W89-12203

CATALYSED FORMATION OF CHLORINATED ORGANIC MATERIALS IN WATERS.
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-12210

BAROON POCKET DAM (AUSTRALIA) RECREATION STRATEGY: AN APPROACH TO A PLAN.
Knight (Sinclair) and Partners Pty Ltd., Spring Hill (Australia).
W. V. Wight.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 105-110, 1989. 4 ref.

Descriptors: *Dams, *Reservoirs, *Recreation, *Tourism, *Management planning, Baroon Pocket Dam, Australia.

Baroon Pocket Dam is a water supply reservoir being constructed in the Sunshine Coast of Queensland. A consultant was engaged to assess recreational opportunities and to prepare a management plan with regard to: the existing occupation of the catchment; the picturesque nature of the locality; the current popularity of the locality for tourists and day trip visitors; and the rare opportunity for 'white water' recreation downstream. Assessment of opportunities and constraints included adaptation of 'Outdoor Recreational Opportunity Spectrum' techniques. As the stored water will require extensive treatment in any case, the nature and intensity of recreation was found to be constrained by factors other than water quality. Opinion gathered through public submissions and discussions with user groups was overwhelmingly opposed to motorized activity. Tranquility and maintenance of the visual setting were valued highly. The retention of land in private ownership in close proximity to the ponded area imposed further constraints on recreation management. (Author's abstract)
W89-12217

STUDY OF RECREATIONAL USE OF SYDNEY WATER BOARD AND FISH RIVER WATER SUPPLY STORAGES (AUSTRALIA).
Longworth and McKenzie Consultants Pty Ltd., Crows Nest (Australia).
I. H. Sharp, and M. A. Schell.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 119-122, 1989. 1 fig, 2 ref.

Descriptors: *Economic aspects, *Recreation, *Water management, *Watershed management, *Water quality control, Cost analysis, Australia, User charges.

Existing and potential recreational uses in a number of very different water supply catchments managed by two major N.S.W. authorities, the Sydney Water Board and the N.S.W. Public Works Department Fish River Water Supply, were investigated. Both studies showed that the community would not accept an increase in water rates or a decrease in water quality which could be directly attributed to the provision of increased recreational opportunities. The Water Board study confirmed the need for additional land and water based activities in Sydney's outer western suburbs and that the community would accept a user pays basis for any increase in facilities and opportunities. This user pays system would allow for an increase in staffing and management to control the additional activities. A program was recommended to correlate the data from water quality monitoring operations with information on specific user activities to produce a basis for future decisions on increased recreational use. The Fish River Study showed that any expansion of recreational activities must be accompanied by the formulation and implementation of appropriate management strategies including increased water quality monitoring. However, as there is currently little demand for an increase in the recreation facilities and opportunities, the recreation management strategy should concentrate on achieving greater control over existing users by the introduction of effective regulations and using water quality information gathered in an expanded monitoring program as a basis for regulating use. (Sand-PTT)
W89-12219

RECREATIONAL USE OF THE CATCHMENTS AND STORAGES OF SYDNEY WATER BOARD (AUSTRALIA).
Sydney Water Board (Australia). Headworks Branch.
L. G. Petrie, and J. D. Wrigley.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 129-133, 1989. 2 ref.

Descriptors: *Recreation, *Catchment areas, *Storage reservoirs, *Urban planning, *Australia, Water quality, Water supply.

In 1986 the Sydney Water Board completed a public review and survey of the present and potential future use of its water supply catchment areas and storages for recreational purposes. The study concluded that there is both broad community support for its strong protection of the water supply and significant interest in use of additional recreational facilities. The Board has identified a number of additional requested recreational opportunities that can be introduced while maintaining present levels of water quality protection and conservation values. These additional items include additional nature walks near some of the existing dam picnic areas, tours of the catchment areas, walking trails and increased river fishing in the Warragamba Catchment Area. Additional recreational facilities are being introduced at Prospect Reservoir. These new initiatives will be introduced as part of an ongoing program of review. The Board is concerned that no recreational activity should be introduced that is likely to cause future problems with water quality protection. Future introduction of increased water treatment levels will enable a further review of catchment protection policies but the high costs of such treatment will cause the Board to delay those introductions as long as practicable. The Board has fully reviewed its present policy on recreational use and has concluded that the general policy is appropriate and has strong community support. The implementation of that policy is being modified to provide for acceptable additional facilities for which there is a demonstrated community need. (Author's abstract)
W89-12221

IMPORTANCE OF HIGH AESTHETIC QUALITY POTABLE WATER IN TOURIST AND RECREATIONAL AREAS.
Queensland Univ., Brisbane (Australia). Dept. of Microbiology.
L. I. Sly, M. C. Hodgkinson, and V. Arunpairojana.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 183-187, 1989. 1 fig, 2 tab, 17 ref.

Descriptors: *Potable water, *Drinking water, *Water quality, *Organoleptic properties, *Tourism, *Recreation, *Water treatment, Manganese, Color, Odors, Taste Turbidity, Chlorination, Iron, Swimming pools.

Tourists have high expectations of the living standards in tourist and recreational areas and are usually less tolerant of substandard services than are local residents. One of the most obvious services experienced by tourists is the drinking water qual-

ity. Whereas the microbiological quality of drinking water is usually well controlled with respect to public health risk, many communities experience problems with the aesthetic quality of their water supplies. Such problems include color and turbidity, taste and odor, and overchlorination. In areas where raw water sources contain Mn and Fe it is essential that these nuisance metals are treated out to low levels. Failure to do so results in the accumulation of metal oxides in biofilm or chemical coatings on the surfaces of water mains. When this material sloughs off, consumers receive 'dirty water' which causes irreversible staining of laundry and recreational facilities such as swimming pools. Communities which rely on tourism as their major industry must pay serious attention to the treatment of their potable water or face the economic consequences of having a poor reputation. Current research on the relationship between Mn concentration and comsumer acceptability has indicated that WHO and NHMRC recommended levels for Mn in drinking water are not sufficiently low to meet the high aesthetic quality requirements of water in tourist and recreational areas. (Author's abstract)
W89-12227

WATER AND WASTEWATER TREATMENT FOR A SMALL ISLAND RESORT.
Queensland Inst. of Tech., Brisbane (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 3A.
W89-12228

RECREATIONAL USE CONSIDERATIONS OF THE SUGARLOAF RESERVOIR (MELBOURNE, AUSTRALIA).
Melbourne and Metropolitan Board of Works (Australia). Investigation and Research Branch.
For primary bibliographic entry see Field 6D.
W89-12238

NO ADVERSE ENVIRONMENTAL IMPACTS FROM WATER PLANT DISCHARGES.
Illinois State Water Survey Div., Peoria. Water Quality Section.
S. D. Lin.
Water Engineering and Management WENMD2, Vol. 136, No. 4, p 40-41, April 1989.

Descriptors: *Water treatment, *Alum sludge, *Bottom sediments, *Macroinvertebrates, *Water pollution effects, Water quality, Sediments, Sludge disposal.

For more than a decade the Water Quality Section of the Illinois State Water Survey has investigated the environmental impacts of alum sludge discharge on receiving streams. The results, published in four reports between 1979 and 1987, indicated that the discharges from four water treatment plants showed generally no adverse effects on water quality, stream bottom sediments, or types and densities of macroinvertebrates at near-shore stations upstream or downstream of the waste outfall. Near-shore sediments, including those within the impacted areas, supported a higher density and diversity of macroinvertebrates than sediments at any of the other stations. Due to bottom sediment characteristics of sand and silt, the gelatinous alum sludge tends to create a better biotic environment. Environmental degradation was limited to a small area near the discharge outfalls. (Sand-PTT)
W89-12249

BIOTREATMENT OF DILUTE CONTAMINATED GROUND WATER USING AN IMMOBILIZED MICROBE PACKED BED REACTOR.
Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5G.
W89-12300

RADON IN GROUND WATER SUPPLIES.
For primary bibliographic entry see Field 5B.
W89-12309

EPIDEMIC OF NOSOCOMIAL LEGIONNAIRES' DISEASE IN RENAL TRANSPLANT RECIPIENTS: A CASE-CONTROL AND ENVIRONMENTAL STUDY.
Manitoba Univ., Winnipeg. Dept. of Microbiology
N. M. LeSaux, L. Sekla, J. Mcleod, S. Parker, and D. Rush.
Canadian Medical Association Journal CMAJAX, Vol. 140, No. 9, p 1047-1053, May 1 1989. 2 fig, 3 tab, 35 ref.

Descriptors: *Water treatment, *Disinfection, *Legionella, *Potable water, *Human diseases, *Hospitals, *Human pathology, Pathogens, Bacteria, Water storage, Water tanks, Population exposure, Chlorination, Superheating.

An outbreak of Legionella pneumophila pneumonia occurred in 6 of 49 new renal transplant recipients over the course of 13 months. Infected patients (cases) and uninfected patients (controls) were compared with respect to potential risk factors. Corticosteroid use, need for hemodialysis and number of days of hemodialysis were significantly greater among the cases. Logistic regression analysis identified corticosteroid dosage and number of days of hemodialysis as independent risk factors. All clinical isolates were of L. pneumophila serogroup 1, subtype Philadelphia 1, which was also cultured from a recovery room sink outside the operating room where the transplants were done. Other areas of the hospital were colonized with other, heterogeneous strains of L. pneumophila. The organism was not eliminated from the hospital water supply despite shock chlorination and superheating of water tanks. The epidemic ended when new transplant recipients routinely received prophylactic trimethoprim-sulfamethoxazole (160-800 mg given orally once daily) while in hospital after transplantation. Corticosteroid-induced monocytopenia and lymphopenia and the complement activation and monocyte depletion effects of hemodialysis may combine to increase susceptibility to Legionnaires' disease. (Author's abstract)
W89-12367

ENDOGENOUS NITROSATION IN RELATION TO NITRATE EXPOSURE FROM DRINKING WATER AND DIET IN A DANISH RURAL POPULATION.
Landsforeningen til Kraeftens Bekaempelse, Copenhagen (Denmark).
H. Moller, J. Landt, E. Pedersen, P. Jensen, and H. Autrup.
Cancer Research CNREA8, Vol. 49, No. 11, p 3117-3121, June 1 1989. 1 fig, 5 tab, 39 ref.

Descriptors: *Drinking water, *Nitrates, *Carcinogens, *Public health, *Denmark, Population exposure, Potable water.

Increasing levels of nitrate in drinking water is of concern due to the possibility of an associated increase in long-term exposure to endogenously formed carcinogenic N-nitroso compounds. Excretion of N-nitrosoproline in 12-h overnight urine after intake of 500 mg L-proline was used to quantify the rate of endogenous nitrozation in 285 individuals in an area in northern Denmark with large variation in nitrate concentration of the drinking water. Nitrate intake was measured in a 24-h duplicate diet sample. The crude association between nitrate concentration in drinking water and rate of endogenous nitrozation in individuals is only weakly positive and not quite statistically significant ($P = 0.08$). The risk of having detectable nitrozation increases significantly with total nitrate intake and tobacco smoking. In nonsmokers, nitrozation is determined by nitrate intake. Smokers have increased nitrozation, which does not depend on nitrate intake. Effect modification through dietary factors was evaluated and indicated a protective effect of tea consumption, while the effect of eating vegetables was not clear-cut. The experimental design (12-h urine sample; proline dose taken in the evening) is likely to underestimate the effect of nitrate in drinking water relatively to nitrate in the diet. (Author's abstract)
W89-12368

BACTERIAL CONTAMINATION OF STORED WATER AND STORED FOOD: A POTENTIAL SOURCE OF DIARRHOEAL DISEASE IN WEST AFRICA.
Statens Seruminstitut, Copenhagen (Denmark). Dept. of Toxoplasmosis.
K. Molbak, N. Hojlyng, S. Jepsen, and K. Gaarslev.
Epidemiology and Infection EPINEU, Vol. 102, No. 2, p 309-316, April 1989. 5 tab, 8 ref.

Descriptors: *Developing countries, *Public health, *Human diseases, *Drinking water, *Water supply, Potable water, Hygiene, Bacteria, Pathogens, Enterobacter, Africa, Liberia.

The food and water hygiene in two Liberian communities was studied in a house-to-house diarrhea survey. The level of contamination with enterobacteria of drinking water stored in the households was significantly higher than at the water sources. Food hygiene standards were low, particularly in the urban slum where storage of cooked food for long periods led to bacterial multiplication at high levels. Infant foods were particularly heavily contaminated. It is concluded that when water supply programs are planned, the presence of other risk factors for water-related diseases should be investigated. To ensure maximum health benefits, water projects should, as a rule, be accompanied by other interventions. The hazardous practices of storing large quantities of drinking water in open containers, for example, as well as storage of cooked food, must be discouraged as must the potential dangers of bottle-feeding and unhygienic practices during weaning. Breastfeeding and hygienic handling of food should be encouraged. (Friedmann-PTT)
W89-12372

CONTINUOUS FLOW METHOD FOR SIMULTANEOUS DETERMINATION OF MONOCHLORAMINE, DICHLORAMINE, AND FREE CHLORINE: APPLICATION TO A WATER PURIFICATION PLANT.
Osaka Prefectural Univ., Sakai (Japan). Lab. of Environmental Chemistry.
For primary bibliographic entry see Field 5A.
W89-12379

ANALYSIS OF INORGANIC AND ORGANIC CHLORAMINES: DERIVATIZATION WITH 2-MERCAPTOBENZOTHIAZOLE.
Minnesota Univ., Duluth. Dept. of Chemistry.
M. T. Lukasewycz, C. M. Bieringer, R. J. Liukkonen, M. E. Fitzsimmons, and H. F. Corcoran.
Environmental Science and Technology ESTHAG, Vol. 23, No. 2, p 196-199, February 1989. 2 fig, 5 tab, 15 ref.

Descriptors: *Chemical analysis, *Chlorinated hydrocarbons, *Sample preparation, *Wastewater renovation, Water analysis, High pressure liquid chromatography, Chemical reactions, Chlorination.

Knowledge of the amine content present during water renovation processes involving chlorination is important to define more adequately the content of a matrix now described only as 'combined residual chlorine' or 'chlorine produced oxidants' and because of the variation in disinfectant capability and other chemical and biological activities of the chloramine species that are generated. However, the presence of 'organic nitrogen' and the instability of many organic chloramines continue to challenge the analyst. A technique has been developed for the analysis of chloramine and organic chloramines present in water using 2-mercaptobenzothiazole as the derivatizing agent. The resulting sulfenamides (-S-N<) are stable and can be conveniently analyzed by HPLC using ultraviolet or electrochemical detection. The efficiency of the conversion varied considerably with structure of the chloramine and with the amine/chloramine ratio. However, within each set of conditions, the extent of derivatization was quite reproducible. Moreover, a standard curve can be developed over a significant range of concentrations, which provides additional incentive for use of the technique. The rapid and convenient derivatization of chloramines using 2-mercaptobenzothiazole therefore offers

some distinct advantages over the use of dansylation as a method of detection. However, the quantitation of chloramines, which is possible with formation of these sulfenamides, is limited practically to those situations where individual amine content does not vary substantially from sample to sample. It is in these situations where standard curves can be developed and advantage can be taken of the reproducibility of the process. (Author's abstract)
W89-12388

ENERGY FROM SOLAR PONDS: CONTROL OF THE GREEN FLAGELLATE DUNALIELLA USING OSMOTIC SHOCK OF DILUTION.
Hebrew Univ. of Jerusalem (Israel). Human Environment Sciences Div.
I. Dor, and B. Doron.
Environmental Science and Technology ESTHAG, Vol. 23, No. 2, p 227-231, February 1989. 8 fig, 1 tab, 25 ref.

Descriptors: *Solar energy, *Dunaliella, *Saline water, *Algal control, Dead Sea, Chlorophyta, Eutrophication, Temperature effects, Heating, Israel.

The study was conducted in the vicinity of the Dead Sea, Israel in connection with an experimental solar pond being tested as a source of low-grade heat for conversion into electricity. The hypersaline water of such a pond, acting as a solar collector, must be maximally transparent to allow for efficient transport of light energy to the pond's deep storage layer. This research evaluates the extent of interference caused to the solar pond system by a halo-tolerant, unicellular flagellate Dunaliella, predicts blooms of this alga according to its environmental requirements, and provides means for control of its growth. The method proposed for control is based on osmotic shock of dilution applied to the algal population by a periodic rapid inflow of fresh water. As a result of biochemical, physiological, and morphological changes, Dunaliella cells sink and are destroyed when they reach the deep hot water layer. (Author's abstract)
W89-12390

CONTROLLING ORGANICS WITH GAC: A COST AND PERFORMANCE ANALYSIS.
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
J. Q. Adams, R. M. Clark, and R. J. Miltner.
Journal of the American Water Works Association JAWWA5, Vol. 81, No. 4, p 132-140, April 1989. 9 fig, 3 tab, 18 ref.

Descriptors: *Activated carbon, *Performance evaluation, *Cost analysis, *Water treatment, Legislation, Organic compounds, Legal aspects, Economic aspects, Adsorption, Chlorinated hydrocarbons, Pesticides, Odor control, Taste, Costs.

The amendments to the U.S. Safe Drinking Water Act require extensive evaluation of the feasibility of removing organic compounds using granular activated carbon (GAC). To meet deadlines for this technology evaluation, the EPA has combined the use of column studies and adsorption modeling with cost models to make projections for the performance of full-scale GAC systems. A representative list of synthetic organic chemicals was studied, and cost and performance results for GAC treatment are presented in this article. Many of the synthetic organic chemicals examined had predicted bed lives of two years or longer, which is typical of taste and odor control applications. Cost estimates for GAC treatment of these compounds appear to range from about $0.41 to 0.27 to 0.14/1,000 gal of 1-mgd, 10-mgd, and 100-mgd systems, respectively. Determination of a minimum-cost empty bed contact time (EBCT) must be evaluated case by case and depends on factors such as influent concentration, effluent goal, multisolute competition, and effects of other background organic matter on the carbon. However, there may be a range of EBCTs that provides near minimum cost systems. This may allow some flexibility in adsorber design and operation. The cost estimating tools presented here should be useful for preliminary planning. (Doria-PTT)
W89-12391

EFFECT OF PRELOADING ON THE SCALE-UP OF GAC MICROCOLUMNS.
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
T. F. Speth, and R. J. Miltner.
Journal of the American Water Works Association JAWWA5, Vol. 81, No. 4, p 141-148, April 1989. 6 fig, 7 tab, 33 ref.

Descriptors: *Activated carbon, *Water treatment, *Organic carbon, Model studies, Isotherms, Distilled water, Groundwater, Aquifers, Chlorinated hydrocarbons, Adsorption.

A previously presented microcolumn scale-up procedure is evaluated. Scale-up assumptions that involve equal capacities in microcolumns and field columns are studied in an effort to determine whether preloading activated carbon with a natural water significantly reduces the carbon's capacity for a target compound. The capacities observed in the column studies are compared with isotherms for distilled-deionized water, groundwater, and groundwater with preloaded carbon. Total organic carbon breakthrough in the field column is presented to explain capacity reductions. A simplified version of a mass transfer model and a more complex model are used to predict the pilot-column results. Water from the Great Miami Aquifer (GMA) in southwestern Ohio was used. For this groundwater, preloading naturally occurring organic material onto granular activated carbon reduced the carbon's capacity for cis-1,2-dichloroethene. This preloading violated an assumption of a previously presented microcolumn scale-up procedure. Preloading of natural waters was therefore found to render incomplete carbon adsorption models that do not account for the possible reduction in capacity. Of the models that do not take preloading into account, the simple constant pattern homogeneous surface diffusion model gives a comparable prediction to the dispersed flow pore surface diffusion model, which incorporates more kinetic terms. (Doria-PTT)
W89-12392

DETERMINATION OF PRACTICAL QUANTITATION LEVELS FOR ORGANIC COMPOUNDS IN DRINKING WATER.
American Water Works Association Research Foundation, Denver, CO.
For primary bibliographic entry see Field 5A.
W89-12393

ADSORPTION OF HUMIC SUBSTANCES IN THE PRESENCE OF SODIUM SALTS.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
P. Lafrance, and M. Mazet.
Journal of the American Water Works Association JAWWA5, Vol. 81, No. 4, p 155-161, April 1989. 11 fig, 1 tab, 16 ref.

Descriptors: *Adsorption, *Activated carbon, *Humic acids, *Sodium compounds, *Water treatment, Salts, Hydrogen ion concentration, Anions, Zeta potential, Organic carbon, Sodium chloride, Phosphates, Calcium chloride.

The possible effects of some sodium salts on the adsorption of humic acids are discussed in light of experimental measurements of the electrokinetic potential of powdered activated carbon. Inorganic sodium salts were found to enhance the adsorptive capacity of activated carbon for humic substances. The interactions between the salts and the surface of the carbon were investigated as a function of salt type and concentration by zeta potential measurements. At a constant pH, increasing the concentration of humic substances markedly increased the magnitude of the negative value of the zeta potential, whereas increasing salt concentration neutralized the zeta potential. The anion of the salts had little effect on adsorptive capacity or on the change in the zeta potential. Sodium ion concentration is thus the primary factor responsible for the increased adsorption of humic substances, probably via the neutralization of negative charges on both humate molecules and carbon surface functional groups. (Doria-PTT)
W89-12394

USING A MICROPOROUS HOLLOW-FIBER MEMBRANE TO SEPARATE VOCS FROM WATER.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
M. J. Semmens, R. Qin, and A. Zander.
Journal of the American Water Works Association JAWWA5, Vol. 81, No. 4, p 162-167, April 1989. 9 fig, 2 tab, 25 ref.

Descriptors: *Reverse osmosis, *Air stripping, *Physicochemical treatment, *Membranes, *Organic compounds, *Water treatment, Polymers, Model studies, Aeration, Chlorinated hydrocarbons, Chloroform, Flow, Gas chromatography, Electron capture gas chromatography, Cost analysis, Economic aspects, Performance evaluation.

The use of microporous polypropylene hollow fibers for separating volatile organic contaminants (VOCs) from water was evaluated. The water was pumped through the lumen of the fibers, and organic-free air was pumped countercurrently on the outside of the fibers. The rate of VOC removal was modeled on the basis of known empirical correlations, and the experimental data compared favorably with theoretical predictions. The use of a membrane in the air-stripping process offers several potential advantages over conventional packed-tower aeration, including a higher overall mass transfer coefficient (K sub L a), a reduced dependence of K sub L a on gas flow rate, no upper limit on the gas flow rate that can be used, no need for mist elimination, and no need for tall structures. Because the performance of the module is independent of fiber diameter, the module should be designed to minimize operating costs. Pumping water through the lumen of the fibers is likely to be a major expense, and the cost is a strong function of fiber diameter. It is, therefore, desirable to use large-diameter fibers to reduce this cost. However, hollow fibers have only been produced with diameters as large as 400 microns because there are technical difficulties associated with the production of fibers having a larger diameter. Pumping costs may also be minimized by reducing fiber length, which will not influence performance if a correspondingly larger number of fibers is used. (Doria-PTT)
W89-12395

INITIATION OF MICROPOLLUTANT BIODEGRADATION IN VIRGIN GAC COLUMNS.
Texas Univ. at Austin. Dept. of Civil Engineering.
G. E. Speitel, M. H. Turakhia, and C.-J. Lu.
Journal of the American Water Works Association JAWWA5, Vol. 81, No. 4, p 168-176, April 1989. 11 fig, 3 tab, 22 ref.

Descriptors: *Biodegradation, *Activated carbon, *Water treatment, *Phenols, Trace levels, Industrial wastes, Degradation, Chlorination, Ozonation, Sorption, Lake Houston, Isotherms, Temperature, Pilot plants, Adsorption, Porosity, Organic carbon.

Experiments were conducted in virgin granular activated carbon (GAC) columns supplied with treated surface water and the synthetic organic chemicals (SOCs) phenol and 2,4-dichlorophenol (DCP). Surface water from Lake Houston, TX was subjected to one of three chemical treatments: chlorination, no oxidant addition, or ozonation. The GAC columns were seeded only with microorganisms that passed through conventional treatment. The main objective was a determination of the time required to initiate significant biodegradation of trace concentrations of SOCs. The impact of naturally occurring organic compounds and the type of pretreatment on biodegradation were also of interest, as was biodegradation of sorbed SOCs. Significant biodegradation of phenol and DCP in the liquid phase commenced after one month of operation in columns with contact times of < 1 min. Sorbed phenol was biodegraded to a large extent, whereas biodegradation of sorbed DCP was negligible. Total organic carbon removal

across the GAC columns was dependent on chemical pretreatment. Ozonation caused an increase in microbial activity in comparison to no oxidant addition, but this did not provide improved removal of DCP. (Author's abstract)
W89-12396

EVALUATION OF SURFACE AND FILM DIFFUSION COEFFICIENTS FOR CARBON ADSORPTION.
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-12478

PREOZONATION AS AN AID IN THE COAGULATION OF HUMIC SUBSTANCES--OPTIMUM PREOZONATION DOSE.
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
M. R. Farvardin, and A. G. Collins.
Water Research WATRAG, Vol. 23, No. 3, p 307-316, March 1989. 3 fig, 4 tab, 59 ref.

Descriptors: *Wastewater treatment, *Pretreatment of water, *Humic substances, *Ozonation, *Water treatment, *Organic matter, Turbidity, Organic carbon, Alum, Water quality standards, Color, Coagulation, Flocculation, Colloids.

Using a number of commercial and natural water humic substances, the positive effect of preozonation as an aid to coagulation-flocculation of these compounds was confirmed by a 13-30% decrease in alum consumption. Experiments were conducted at a pH of 5.5 and humic substance concentrations of 20 milligrams per liter (total organic carbon concentrations of approximately 10 milligrams per liter). Standard jar test procedures were used to evaluate alum dosage requirements and the primary water quality parameters monitored were turbidity, ultraviolet, total organic carbon, and color. In addition to decreased alum consumption the existence of an optimum preozonation dose (OPD) was also confirmed. For ozone dosages beyond the OPD, the benefit is reduced, then eliminated, and further ozonation becomes detrimental to the coagulation-flocculation removal process. The OPD was found to be a function of the initial colloidal charge density (CCD) of the humic substances. The strong correlation of initial CCD to the OPD identified the major mechanism for preozonation to be effective as a reduction in CCD due to mild ozonation. Preozonation did not show a positive effect on a system with very low molecular weight (noncolloidal) humic substances. (Author's abstract)
W89-12483

ANALYSIS OF DISINFECTION DATA FROM DILUTION COUNT EXPERIMENTS.
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas.
Water Research WATRAG, Vol. 23, No. 3, p 345-349, March 1989. 3 fig, 2 tab, 18 ref.

Descriptors: *Infection, *Water treatment, *Wastewater treatment, *Disinfection, *Statistical analysis, *Monte Carlo method, *Data interpretation, *Most probable number test, Least squares method, Poisson ratio method, Error analysis, Survival, Estimating equations.

When disinfection experiments are conducted using dilution count methods, e.g., most probable number (MPN) tests or animal infectivity assays, inactivation parameters may be assessed in three different ways. First, the density of survivors may be determined by MPN tables and two-step linear regression (or 'eyeball') methods used to estimate Chick-Watson parameters. Second, the survivor density versus concentration and time may be used in a non-linear least squares procedure to estimate inactivation parameters. Third, a maximum likelihood estimation in which the actual numbers of positive and negative tubes as a function of experimental conditions and sample volume may be executed. Using Monte Carlo simulation, it is determined that the third method is optimal (in terms of bias and standard error) for Poisson, or nearly Poisson error distribution. For more overdisperse error structure, however, nonlinear regression performs more satisfactorily. An empirical test of overdispersion is proposed as a diagnostic tool for assessing the optimum method for data analysis. (Author's abstract)
W89-12488

BIOLOGICAL FIXED-FILM SYSTEMS.
New Hampshire Univ., Durham. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-12509

MATHEMATICAL INTERPRETATION OF AQUEOUS-PHASE OZONE DECOMPOSITION RATES.
Connecticut Univ., Storrs. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-12616

PREDICTING GAS-PHASE ADSORPTION EQUILIBRIA OF VOLATILE ORGANICS AND HUMIDITY.
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
J. C. Crittenden, T. J. Rigg, D. L. Perram, S. R. Tang, and D. W. Hand.
Journal of Environmental Engineering (ASCE) JOEEDR, Vol. 115, No. 3, p 560-573, June 1989. 5 fig, 18 ref.

Descriptors: *Water treatment, *Air stripping, *Adsorption, *Organic compounds, *Thermodynamics, *Equilibrium, *Humidity, Vaporization, Physico-chemical properties, Mathematical studies, *Volatility, Activated carbon, Air pollution.

There are several potential technologies for removing volatile organic compounds from water supplies. The most common are aqueous-phase granular activated carbon (GAC) adsorption and air stripping. Air stripping is considerably cheaper than aqueous-phase adsorption. However, there are concerns about air pollution resulting from air-stripper off-gas and the air pollution problems may be remedied by treating the off-gas with a fixed-bed GAC adsorber. Several thermodynamic models that may be used to predict single and binary adsorption equilibria for organic vapors and competitive interactions between water vapor and a single organic vapor were developed and tested. The low organic vapor concentrations and humidities that were examined are similar to those that would be encountered in air stripping tower air emissions. The Dubinin-Radushkevic (D-R) equation was shown to predict single-component adsorption equilibria for trichloroethene (TCE) and tetrachloroethene (PCE) using a reference isotherm which was conducted on toluene and physical properties of TCE and PCE. Both the polanyi potential theory and ideal adsorbed solution theory (IAST) were shown to predict binary adsorption equilibria of TCE and PCE using single component isotherm data. The competitive interactions between water vapor and TCE were predicted using TCE isotherm data (which was conducted at low relative humidities), a water vapor isotherm, and the pore size distribution of the carbon. (Author's abstract)
W89-12617

KINETICS OF OZONATION OF IRON(II) AND MANGANESE (II) IN A PURE WATER SYSTEM.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
M. Y. Abukhudair, S. Farooq, and M. S. Hussain.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24, No. 4, p 389-407, May 1989. 8 fig, 1 tab, 8 ref.

Descriptors: *Water treatment, *Drinking water, *Ozonation, *Heavy metals, *Iron, *Manganese, Chemical reactions, Groundwater pollution, Ozone, Hydrogen ion concentration, Chemical properties, Oxidation, Anaerobic conditions.

Iron(II) and manganese(II) are the two most common chemical species that exist in groundwater under anaerobic conditions, i.e., in the absence of dissolved oxygen and low pH. These two forms are soluble in water and present many problems to consumers at concentrations of more than 0.3 mg/L and 0.05 mg/L, respectively. A study was conducted to determine the effects of ozonation on the removal of iron(II) and manganese(II) at different pH values in a pure water system. It was found that the rates of oxidation of iron(II) and manganese(II) follow a zero-order reaction. The respective values of detention time and applied ozone dosage for removal of 4 mg/L of iron(II) were 10-15 min and 3-5 mg/L, as compared with 20-30 min. and 4-6 mg/L for the removal of 4 mg/L of manganese(II). No iron(II) and manganese(II) were detected in the pure water system above the pH values of 7 and 9, respectively. The oxidation rates of iron(II) at pH of 6, ozone dosage of 1.96 mg/L, and initial iron (II) concentrations of 4, 3, 2, and 1 mg/L are 0.49, 0.41, 0.372, and 0.352 mg/min, respectively. (Friedmann-PTT)
W89-12627

DIFFERENTIAL DEPURATION OF POLIOVIRUS, ESCHERICHIA COLI, AND A COLIPHAGE BY THE COMMON MUSSEL, MYTILUS EDULIS.
University Coll., Cork (Ireland). Virology Unit.
For primary bibliographic entry see Field 5B.
W89-12650

EFFECT OF DISINFECTION OF DRINKING WATER WITH OZONE OR CHLORINE DIOXIDE ON SURVIVAL OF CRYPTOSPORIDIUM PARVUM OOCYSTS.
Institut National de Recherches Veterinaires, Brussels (Belgium).
J. E. Peeters, E. A. Mazas, W. J. Masschelein, I. V. M. de Maturana, and E. Debacker.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 6, p 1519-1522, June 1989. 2 tab, 26 ref.

Descriptors: *Pathogens, *Water treatment, *Disinfection, *Ozone, *Chlorine, *Drinking water, *Protozoa, Chlorine dioxide, Feces, Human diseases, Animal diseases.

Demineralized water was seeded with controlled numbers of oocysts of the protozoan Cryptosporidium parvum purified from fresh calf feces and subjected to different treatments with ozone or chlorine dioxide. The disinfectants were neutralized by sodium thiosulfate, and neonatal mice were inoculated intragastrically and sacrificed 7 days later for inumeration of oocyst production. Preliminary trials indicated that a minimum infection level of 1,000 oocysts (0.1-ml inoculum) per mouse was necessary to induce 100% infection. Treatment of water containing 10,000 oocysts per ml with 1.11 mg of ozone per liter (concentration at time zero (C sub 0)) for 6 min totally eliminated the infectivity of the oocysts for neonatal mice. A level of 2.27 mg of ozone per liter (C sub 0) was necessary to inactivate water containing 500,000 oocysts per ml within 8 min. Also, 0.4 mg of chlorine dioxide per liter (C sub 0) significantly reduced infectivity within 15 min of contact although some oocysts remained viable. (Author's abstract)
W89-12658

EFFECTS OF NATURAL ORGANIC MATTER AND CALCIUM ON OZONE-INDUCED PARTICLE DESTABILIZATION.
Camp, Dresser and McKee, Inc., Raleigh, NC.
For primary bibliographic entry see Field 2K.
W89-12697

EFFECTS OF PREOXIDATION WITH OZONE ON WATER QUALITY: A CASE STUDY.
Connecticut Univ., Storrs. Dept. of Civil Engineering.
D. Grasso, W. J. Weber, and J. A. DeKam.
Journal of the American Water Works Association JAWWA5, Vol. 81, No. 6, p 85-92, June 1989. 8

fig, 3 tab, 16 ref.

Descriptors: *Water quality, *Pretreatment of water, *Drinking water, *Water treatment, *Ozone, *Preoxidation, Case studies, Michigan, Seasonal variation, Trihalomethanes, Organic carbon, Chlorination, Statistical analysis, Water softening.

An integrated pilot-scale and full-scale study and associated statistical data analyses were conducted to evaluate the effects of ozone on water quality in several different treatment schemes. The study was carried out over two seasons in 1985: summer (April-July) and fall (August-December) at the Bay Metro plant in Bay City, Mich. Statistically significant differences in mean influent parameter concentrations were observed between the two seasons, making direct comparison of results between the seasons difficult. Despite this limitation, certain observations and conclusions can be drawn from the study. It appeared that low dosages of ozone (0.75 mg/L) increased levels of total organic carbon, but the effect leveled off at higher ozone concentrations (1.5 mg/L). Ultraviolet absorbance, however, was observed to decrease with increasing ozone dosage. No correlation was found between ozone dosage and turbidity reduction. Although the reduction in trihalomethane formation potential (THMFP) generally increased immediately after single-stage application of ozone, overall THMFP reduction for two-stage ozonation was shown to decrease with ozone concentration for several phases of experimentation, especially when softening followed ozonation or when chlorination was conducted at high pH levels. (Author's abstract)
W89-12698

ADSORPTION EQUILIBRIA OF NATURAL ORGANIC MATTER AFTER OZONATION.
Pirnie (Malcolm), Inc., Newport News, VA.
G. W. Harrington, and F. A. DiGiano.
Journal of the American Water Works Association JAWWA5, Vol. 81, No. 6, p 93-101, June 1989. 13 fig, 4 tab, 29 ref. EPA Exploratory Research Program Grant R811824.

Descriptors: *Water treatment, *Drinking water, *Organic matter, *Equilibrium, *Ozonation, Coagulation, Adsorption, Isotherms.

The equilibrium adsorption behavior of natural organic matter (NOM) subjected to coagulation and various levels of ozonation and biostabilization was investigated in bench-scale experiments. Ideal adsorbed solution theory provided a mathematical description of overall NOM adsorption isotherms and showed how the shape and position of NOM adsorption isotherms depend on changes in initial concentration and solution composition. The overall adsorbability of NOM increased with coagulation but decreased if coagulation was followed by ozonation and biostabilization. Without adsorption, ozonation was shown to enhance the biodegradability of coagulated NOM; up to 46 percent of total organic carbon was described quantitatively by accounting for competitive adsorption among pseudocomponents and by applying concepts of polymer adsorption. The normalized isotherm approach does not account for competing NOM components and, as such, may be limited in predicting the competition of NOM with synthetic organic chemicals that may be in solution. In addition, this approach needs further examination to determine its applicability in predicting dynamic adsorber performance. Results with the ideal adsorbed solution theory approach did not predict changes in adsorbability upon treatment. Neither approach was entirely satisfactory for obtaining a systematic relationship between adsorbability and ozone dosage. (Author's abstract)
W89-12699

TECHNICAL NOTE: ELIMINATING INTERFERENCES IN THE DPD METHOD FOR RESIDUAL OZONE.
For primary bibliographic entry see Field 7B.
W89-12700

IONOMETRIC DETERMINATION OF CHLORINE IONS IN DESALTED WATER (IONOMETRICHESKOE OPREDELENIE IONOV KHLORA V OBESSOLENNOI VODE).
Nauchno-Isaledovatel'ski Inst. Electroionnoi Technologii.
N. G. Gogadze, T. M. Alkhazishvili, and E. V. Davtyan.
Soobshcheniia Akademii Nauk Gruzinskoi SSR SAKNAH, Vol 131, No 2, p 305-308, August 1988. 3 fig, 2 ref. English summary.

Descriptors: *Pollutant identification, *Water treatment, *Residual chlorine, *Potable water, Water analysis, Chemical analysis, Ion-selective electrodes.

An ionometric method was developed to determine Cl ions over the range .00031 mole/L to 1 mole/L. The method is applicable to the determination of Cl ions in chlorinated purified potable water. (Author's abstract)
W89-12714

GROUNDWATER CONTAMINATION: PUMP-AND-TREAT REMEDIATION.
California Univ., Los Angeles. School of Public Health.
For primary bibliographic entry see Field 5G.
W89-12756

INACTIVATION OF GIARDIA MURIS AND INDICATOR ORGANISMS SEEDED IN SURFACE WATER SUPPLIES BY PEROXONE AND OZONE.
Southern California Metropolitan Water District, La Verne.
R. L. Wolfe, M. H. Stewart, K. N. Scott, and M. J. McGuire.
Environmental Science and Technology ESTHAG, Vol. 23, No. 6, p 744-745, June 1989. 1 fig, 1 tab, 9 ref.

Descriptors: *Ozonation, *Oxidation process, *Bioindicators, *Water treatment, *Disinfection, *Giardia, Microorganisms, Peroxone process, Surface water.

The peroxone process for disinfection is optimized by altering H2O2/O3 ratios and contact time. The effectiveness of peroxone and ozone against Giardia muris cysts was also tested. Peroxone is an advanced oxidation process generated by combining ozone and hydrogen peroxide. Microorganisms were seeded into the predisinfection contactor influent of a 6 gal/min pilot plant and exposed three applied ozone dosages (1.0, 2.0, and 4.0 mg/L), five H2)2/O3 ratios (0, 0.05, 0.1, 0.2, and 0.3) and three contact times (6, 9 and 12 min) in California State project water (SPW). Results of the experiments showed that the indicator organisms, with the exception of the heterotrophic plate count group, were highly sensitive to both peroxone and ozone. The results of the study for the inactivation of Giardia in SPW by ozone are in reasonable agreement with the proposed values issued by the EPA for compliance with the Surface Water Treatment Rule. In addition, the study data suggest that peroxone (at a 0.2 ratio of H2O2/O3) is comparable to ozone for the disinfection of indicator organisms and G. muris cysts. (Miller-PTT)
W89-12759

LARGE COMMUNITY OUTBREAK OF CRYPTOSPORIDIOSIS DUE TO CONTAMINATION OF A FILTERED PUBLIC WATER SUPPLY.
Centers for Disease Control, Atlanta, GA.
E. B. Hayes, T. D. Matte, T. R. O'Brien, T. W. McKinley, and G. S. Logsdon.
New England Journal of Medicine NEJMAG, Vol. 320, No. 21, p 1372-1376, May 25, 1989. 1 fig, 25 ref.

Descriptors: *Water supply, *Water treatment, *Human diseases, *Water pollution effects, *Path of pollutants, *Enteric bacteria, *Diseases, *Drinking water, Pathogens, Gastroenteritis, Contamination.

Between January 12 and February 7, 1987, an outbreak of gastroenteritis affected an estimated 13,000 people in a county of 64,900 residents in western Georgia. Cryptosporidium oocysts were identified in the stools of 58 of 147 patients with gastroenteritis (39%) tested during the outbreak. Studies for bacterial, viral, and other parasitic pathogens failed to implicate any other agent. In a random telephone survey, 299 of 489 household members exposed to the public water supply (61%) reported gastrointestinal illness, as compared with 64 of 322 (20%) who were not exposed (relative risk, 3.1; 95 percent confidence interval, 2.4 to 3.9). The prevalence of IgG cryptosporidium was significantly higher among exposed respondents to the survey who had become ill than among nonresident controls. (Author's abstract)
W89-12764

VIRUSES IN RIVER WATER AND HEALTH RISK ASSESSMENT.
Medizinische Akademie 'Carl Gustav Carus' Dresden (German D.R.). Inst. fuer Allgemeine und Kommunale Hygiene.
For primary bibliographic entry see Field 5B.
W89-12781

CHARACTERIZATION OF NON-ENTERIC BACTERIAL REGROWTH IN THE WATER SUPPLY DISTRIBUTION NETWORK FROM A EUTROPHIC RESERVOIR.
University Coll., London (England). Dept. of Civil and Municipal Engineering.
R. A. Gibbs, and C. R. Hayes.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 49-53, July 19, 1989. 1 fig, 4 tab, 7 ref.

Descriptors: *Water analysis, *Bacterial analysis, *Water conveyance, *Water treatment, *Reservoirs, *Bacterial regrowth, Assimilable organic carbon, Chlorination, Pseudomonas, Alcaligenes, Aeromonas, Disinfection, Seasonal variation, Laboratory techniques.

An area of a distribution network receiving organically rich treated water was studied for a period of one year to gain further understanding of the regrowth of bacteria in a water distribution network. These bacteria are considered to be harmless to man. Surveys additional to this study confirmed that enteroviruses and pathogenic bacteria (as defined by EC directives) were absent, consistent with the general absence of coliforms. Fixed points were sampled regularly for bacteriological analysis and for relevant physical and chemical parameters. Heterotrophic plate counts were carried out using standard methods and a study was conducted to test alternative techniques. It was found that bacterial regrowth occurred close to the treatment works and longer retention resulted in little increase in plate counts. Monochloramine residuals of 0.26 mg/L or less did not prevent regrowth. The assimilable organic carbon concentration decreased through the distribution system and increased following booster chlorination. Plate counts showed a seasonal pattern peaking in the spring and autumn and decreasing in the summer and winter. The predominant genera were Pseudomonas, Alcaligenes and Aeromonas with maximum counts of 17,000, 23,000 and 1,700 CFU/ml respectively. Heterotrophic plate counts using the R2A medium, spread plate method and 7-day incubation period were on average 190 times greater than counts using the UK standard method. The increase in count gained by using the alternative method was greatest at the sampling points furthest from the treatment works. (Author's abstract)
W89-12785

SURVIVAL OF HUMAN IMMUNODEFICIENCY VIRUS IN WATER, SEWAGE AND SEA WATER.
Thames Water Authority, London (England).
J. S. Slade, E. B. Pike, R. P. Eglin, J. S. Colbourne, and J. B. Kurtz.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 55-59, July 19, 1989. 3 fig, 1 tab, 5 ref.

Descriptors: *Water treatment, *Disinfection, *Viruses, *Human immunodeficiency virus, *Drinking

water, *Wastewater, *Seawater, *Public health, Survival time, Poliovirus, Herpes simplex virus.

Drinking water treatment serves as an effective barrier against the transmission by water of enteric viruses. Current practices achieve a standard of less than 1 culturable enterovirus/1000 l of treated water. The likely susceptibility of human immunodeficiency virus (HIV) to water treatment processes was assessed in the laboratory by comparing its resistance to environmental stress with that of poliovirus 2 for which quantitative information already exists. HIV cultured in a human T-cell line was added to samples of dechlorinated drinking water, settled raw sewage, and sea water. These were incubated at 16 C and sampled over 11 days. HIV was detected by serial dilution and subculture followed by fluorescent antibody tests for infected cells and by enzyme immune assay for p24 antigen. The survival of herpes simplex virus and poliovirus type 2 was assayed in parallel. The mean times required for a 10-fold decline in HIV concentration were calculated to be 1.8 days in tap water, 2.9 days in sewage, 1.6 days in sea water and 1.3 days in tissue culture fluid controls. A 10-fold decline of poliovirus 2 occurred after 23-30 days in sewage, sea water and tissue culture fluid but in tap water there was no significant decline over 30 days. Herpes simplex was the most sensitive virus requiring only 1.4 days to decline by a factor of 10 in sewage. Controls in tissue culture fluid showed no significant change within 7 days. These tests suggest that although HIV was more robust than herpes simplex virus when associated with the organic matter found in sewage, it was more sensitive than poliovirus, an enterovirus widely used as an indicator of the efficiency of water treatment processes. This susceptibility makes it extremely unlikely that HIV poses any threat to disinfected water supplies. (Author's abstract)
W89-12786

DEVELOPMENT OF FILTRATION/ADSORPTION MEDIA FOR REMOVAL OF BACTERIA AND TURBIDITY FROM WATER.
Regional Engineering Coll., Calicut (India). Dept. of Civil Engineering.
V. S. Prasad, and M. Chaudhuri.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 67-71, July 19, 1989. 4 tab, 6 ref.

Descriptors: *Drinking water, *Water treatment, *Filtration, *Adsorption, *Bacteria, *Turbidity, Escherichia coli, Bituminous coal, Lignite, Manganese ore, Iron ore, Alum, Ferric hydroxide, Lime, Manganese dioxide, Developing countries.

A downflow column test (5 cm bed depth and 5 min bed contact time), employing tap water spiked with Escherichia coli (about 50 CFU/ml) and with or without natural turbidity (50 NTU), was used to screen filtration/adsorption media, prepared from locally available materials in developing countries (bituminous coal, lignite, manganese ore and iron ore, both raw as well as pretreated/impregnated with alum, ferric hydroxide, lime or manganese dioxide), in terms of their capacity to remove bacteria and turbidity from water. Based on bacteria removal and turbidity data, ferric hydroxide impregnated lignite (Fe-lignite) and alum pretreated or lime impregnated manganese ore (alum-Mn ore or lime-Mn ore) ranked top among the 20 media tested, showing 100% removal of E. coli with effluent turbidity not exceeding 5 NTU. In terms of chemical characteristics that may affect the aesthetic quality of drinking water, both Fe-lignite and lime-Mn ore were acceptable; however, Fe-lignite showed the least change in the filtered water quality. Effects of pH (5-10), ionic strength (0.005-0.0125) and temperature (20-35) on E. coli sorption by Fe-lignite were investigated in batch sorption tests. In column tests using canal water with 3 min contact time, Fe-lignite produced filtered water with 0-4 CFU/ml coliforms and turbidity not exceeding 5 NTU. Fe-lignite was found to be a potentially useful media for domestic water filters in rural areas of the developing countries. (Author's abstract)
W89-12788

WASTEWATER TREATMENT FOR EFFLUENT REUSE: LIME-INDUCED REMOVAL OF EXCRETED PATHOGENS.
Leeds Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-12790

REMOVAL OF VIRUSES FROM TAPWATER BY FIBERGLASS FILTERS MODIFIED WITH A COMBINATION OF CATIONIC POLYMERS.
Florida Univ., Gainesville. Dept. of Environmental Engineering.
D. R. Preston, S. R. Farrah, and G. Bitton.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 93-98, July 19, 1989. 3 fig, 2 tab, 13 ref.

Descriptors: *Filtration, *Viruses, *Water treatment, *Drinking water, *Enteroviruses, *Fiberglass filters, Echovirus, Poliovirus, Coxsackie virus.

An inexpensive electropositive filter capable of adsorbing enteroviruses from waters at pH 5 to 9 was developed. It had previously been reported that electronegative microporous filters composed of epoxy-fiberglass (Filterite) treated with the cationic polymers polyethyleimine (PEI) and Nalco 7111 cationic polymer (Nalco) absorb a greater percentage of enteroviruses and indigenous bacteriophages from water than untreated filters. However, no single polymer treated filter was capable of adsorbing poliovirus type 1 from buffer pH 5, 7, and 9. When PEI and Nalco 7111 cationic polymer treated filters were combined as a series of different filters or on the same filter, Poliovirus-1 was subsequently removed from buffer at pH 5, 7, and 9. Filterite filters modified with a combination of PEI and Nalco polymers were found to absorb echovirus type 1, echovirus type 5, coxsackievirus type 1 from tap water at least as well as Virasorb 1-MDS microporous filters. (Sand-PTT)
W89-12792

INCIDENCE OF WATERBORNE AND WATER-ASSOCIATED DISEASE IN SCOTLAND FROM 1945 TO 1987.
Strathclyde Regional Council, Glasgow (Scotland). Water Dept.
C. Benton, G. I. Forbes, G. M. Paterson, J. C. M. Sharp, and T. S. Wilson.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 125-129, July 19, 1989. 5 tab, 13 ref.

Descriptors: *Diseases, *Public health, *Viruses, *Bacteria, *Toxicity, *Scotland, Lead, Copper, Gastroenteritis, Shigellosis, Disinfection.

A review of the incidence of waterborne disease in Scotland from 1945-87 was undertaken in conjunction with the Communicable Diseases (Scotland) Unit and the Scottish Home and Health Department. Primarily, these relate to contamination of private and public supplies by microbiological and chemical agents, but incidents in which water such as river water was ingested deliberately or accidentally were included. Water-related infections such as legionellosis and leptospirosis which are acquired by non-alimentary routes were excluded. During the period of the review there were 57 outbreaks of waterborne disease comprising more than 15,305 cases of illness. A total of 18 outbreaks occurred in public supplies and 21 in private supplies. Microbiological contamination gave rise to the greatest number of cases of waterborne disease which were caused by viral gastroenteritis and shigellosis followed by outbreaks of gastroenteritis of unknown etiology. The highest number of outbreaks were due to chemical poisoning, caused mainly by lead and copper, followed by outbreaks of gastroenteritis of unknown etiology. The type of deficiency giving rise to incidents of waterborne disease were described for private and public water supplies. In public supplies the need for hygienic storage of water in distribution and effective catchment control practices in conjunction with adequate water treatment facilities is emphasized. In private supplies the need to, at minimum, apply rudimentary disinfection to untreated source water is highlighted by the large numbers of people who have been affected by waterborne disease. (Author's abstract)
W89-12797

RECREATIONAL AND AMENITY USE OF SURFACE WATERS: THE PUBLIC HEALTH IMPLICATIONS.
Altwell Ltd., Warrington (England).
F. Jones, and A. F. Godfree.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 137-142, July 19, 1989. 2 fig, 4 ref.

Descriptors: *Recreation, *Water quality, *Public health, *Water pollution effects, Wastewater, Bacteria, United Kingdom, Epidemiology.

Rivers, lakes and coastal waters in the United Kingdom are increasingly being used for water sports and recreation. These waters may receive treated and untreated sewage, storm water, trade effluent and agricultural waste. The potential for harmful health effects exists. Relatively little medical or scientific information is available which allows sound health guidance to be given in this respect. Current advice regarding the suitability of U.K. waters for contact pursuits remains conditioned by the results of a national retrospective epidemiological and bacteriological survey carried out 30 years ago. Moreover, this study was concerned only with the use of sewage-contaminated coastal waters for bathing. The practical difficulties experienced in giving advice has led to the development of a scheme designed to assess health effects in a consistent manner. The scheme takes into consideration the following elements: (1) river classification; (2) proportion of river volume which is sewage or trade effluent; (3) proximity to sources of pollution; (4) bacteriological quality; (5) environmental health factors; and (6) a practical field inspection. This scheme is illustrated by reference to a case study in a section of Liverpool which demonstrated its value as a management tool. (Sand-PTT)
W89-12799

OUTBREAK OF GIARDIASIS AND AMOEBIASIS AT A SKI RESORT IN SWEDEN.
National Bacteriological Lab., Stockholm (Sweden).
Y. Andersson, and D. de Jong.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 143-146, July 19, 1989. 2 fig, 4 ref.

Descriptors: *Water treatment, *Diseases, *Public health, *Epidemiology, *Parasites, *Drinking water, *Wastewater pollution, Reservoirs, Gastroenteritis, Giardia, Entamoeba, Sweden, Infection.

A large number of tourists contracted gastroenteritis at the end of December 1986 at a ski resort in the north of Sweden. The outbreak was due to the intrusion of sewage in the drinking water reservoir through a spillway overflow connected to the sewer. One to three days after drinking the polluted water, at least 3600 persons of 4000 at risk contracted gastroenteritis, an attack rate of 90%. Giardia lamblia was isolated from 1480 persons and Entamoeba histolytica from 106. At least 50 persons contracted a double infection with G. lamblia and E. histolytica. G. lamblia cysts were isolated from two points in the water distribution system. (Author's abstract)
W89-12800

DEVELOPMENT AND OPERATIONAL IMPLEMENTATION OF A MODIFIED AND SIMPLIFIED METHOD FOR DETERMINATION OF ASSIMILABLE ORGANIC CARBON (AOC) IN DRINKING WATER.
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5A.
W89-12802

RAPID DETECTION OF E. COLI IN WATER USING MONOCLONAL ANTIBODIES.
Centre de Recherche de Maisons-Laffitte (France).
For primary bibliographic entry see Field 5A.
W89-12803

RAPID, SPECIFIC AUTOANALYTICAL METHOD FOR THE SIMULTANEOUS DETECTION OF TOTAL COLIFORMS AND E. COLI FROM DRINKING WATER.
Yale Univ., New Haven, CT. School of Medicine.
For primary bibliographic entry see Field 5A.
W89-12805

INACTIVATION OF HEALTH-RELATED MICROORGANISMS IN WATER BY DISINFECTION PROCESSES.
North Carolina Univ., Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 5D.
W89-12806

DISINFECTION OF POLLUTED WATER BY CHLORINE-FLOCCULANT TABLET.
Council for Scientific and Industrial Research, Pretoria (South Africa). Div. of Water Technology.
R. Kfir, B. W. Bateman, B. A. Pitout, and P. Coubrough.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 207-213, July 19, 1989. 2 fig, 1 tab, 26 ref.

Descriptors: *Water treatment, *Disinfection, *Bactericides, *Viricides, *Chlorination, Flocculation, Enteric bacteria, Chlorine tablets, Escherichia coli, Bacteriophage, Viruses, Enteroviruses, Chlor-floc A, Halazone, Chlor-floc B, Dichloro-s-triazine-trione, Poliovirus.

Two water treatment tablets were evaluated for their efficacy of removal of Escherichia coli, coliphage V1 and poliovirus 1 from water. The activity of both tablets is based on flocculation as well as disinfection with additional straining. The tablets differ from each other only in their disinfection source, i.e. Chlor-floc A contains Halazone and Chlor-floc B contains dichloro-s-triazine-trione. Tests were carried out using simulated hard and colored water at room temperature. Results indicated both tablets to be efficient but showed tablet B to be of superior quality. Tablet B eliminated all bacteria and viruses from the test water after 4 minutes at room temperature. Studies on partial removal of the test organisms by filtration or flocculation without chlorination showed that both steps partially removed the organisms, but the combined process of flocculation chlorination followed by filtration proved to be the most effective treatment. (Author's abstract)
W89-12809

EFFECT OF SUSPENDED SOLIDS ON INACTIVATION OF POLIOVIRUS AND T2-PHAGE BY OZONE.
Setsunan Univ., Neyagawa (Japan). Dept. of Industrial and Systems Engineering.
M. Kaneko.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 215-219, July 19, 1989. 4 fig, 1 tab, 6 ref.

Descriptors: *Activated sludge, *Water treatment, *Disinfection, *Viruses, *Bacteriophage, *Viricides, *Ozone, *Suspended solids, Poliovirus, Collins-Selleck model, Model studies.

A study was conducted to quantify the effects of suspended solids on virus inactivation by ozone and to develop guidelines for ozone dosages in disinfection using poliovirus and T2 phage. The curve of virus count reduction could be divided into three phases: an initial large reduction which occurred within 30 seconds of contact between the viruses and ozone, a subsequent logarithmic reduction, and a slow reduction in response to decreasing ozone concentrations. The reduction of the viruses by ozone is expressed well by the Collins-Selleck Model. The presence of suspended solids significantly reduced the rate of virus inactivation. Using data obtained in this study, the model equation gives the following estimates: if 99.99% inactivation is required with a contact time of 5 minutes, an ozone residual of 0.6 mg/L is necessary when suspended solids are not present; with kaolin levels of 1 and 10 mg/L, ozone residuals of at least 0.9 and 3.7 mg/L, respectively, are necessary for 99.99% inactivation in 5 minutes. If more than 1 mg/L of an autoclaved activated sludge is added to the water, the commonly applied dose of ozone is not sufficient to produce more than a 4 log sub 10 reduction in 5 minutes. (Author's abstract)
W89-12810

COMPARATIVE RESISTANCE OF BACTERIOPHAGES ACTIVE AGAINST BACTEROIDES FRAGILIS TO INACTIVATION BY CHLORINATION OR ULTRAVIOLET RADIATION.
Barcelona Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W89-12811

RNA COLIPHAGE QBETA AS A BIOINDICATOR OF THE ULTRAVIOLET DISINFECTION EFFICIENCY.
Tokyo Univ. (Japan). Dept. of Urban Engineering.
For primary bibliographic entry see Field 5D.
W89-12812

MICROBIOLOGICAL EVALUATION OF COPPER:SILVER DISINFECTION UNITS FOR USE IN SWIMMING POOLS.
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
L. K. Landeen, M. T. Yahya, S. M. Kutz, and C. P. Gerba.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 267-270, July 19, 1989. 5 tab, 9 ref.

Descriptors: *Disinfection, *Bactericides, *Copper, *Silver, *Chlorine, *Water treatment, *Swimming pools, Legionella, Escherichia coli, Staphylococcus, Pseudomonas, Streptococcus.

The bactericidal effects of electrolytically generated Cu:Ag ions on pathogenic bacteria of concern in swimming pools, hot tubs and cooling towers were evaluated in disinfection experiments. Cu:Ag ion concentrations generated in well water were 400:40 microgram/L, respectively. Pure cultures of Legionella pneumophila, Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, and Streptococcus faecalis were individually tested in water containing Cu:Ag ions alone, Cu:Ag ions with free chlorine, and free chlorine alone. Greater numbers of organisms were killed after exposure to Cu:Ag ions with 0.2 mg/L free chlorine than in either the Cu:Ag ions or free chlorine alone. L. pneumophila showed greater than a 5 log sub 10 reduction in numbers after 7 minutes exposure to Cu:Ag ions with 0.2 mg/L free chlorine. In comparison, less than a 2 log sub 10 decrease was obtained after exposure to free chlorine alone. E. coli numbers decreased over 4 log sub 10 after 1 minute exposure to Cu:Ag ions with 0.2 mg/L free chlorine and less than a 3 log sub 10 decrease after exposure to free chlorine alone. The majority of the other organisms tested showed the same effect. Electrolytically generated Cu:Ag ions with low levels of free chlorine appear to have greater bactericidal activities than either disinfectant alone. (Author's abstract)
W89-12820

CYTOCHROME OXIDASE AND O-NITROPHENYL-BETA-D-GALACTOPYRANOSIDE FOR IMPROVED AND RAPID CONFIRMATION OF COLIFORMS ENUMERATED BY THE MEMBRANE FILTRATION METHOD.
Welsh Water Authority, Llanelli. South West District Lab.
P. G. Morgan.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 271-274, July 19, 1989. 3 fig, 1 tab, 5 ref.

Descriptors: *Water analysis, *Drinking water, *Bacterial analysis, *Coliforms, *Enterobacter, Chlorine, Legionella, Enzymes.

Coliforms isolated from water supplies are confirmed by acid and gas production in lactose peptone water (LPW), Report 71 (HMSO, 1982). Exposure to chlorine has been shown to suppress acid and gas production in Klebsiella pneumoniae. Thus water supplies containing chlorine-stressed coliforms may be falsely certified as being bacteriologically satisfactory. An alternative method is the cytochrome oxidase and o-nitrophenyl-beta-D-galactopyranoside (CO/ONPG) test, which is based on the characteristic of all lactose fermenters to cleave ONPG using a beta-galactosidase. Cytochrome oxidase distinguishes between aerobes (CO-positive) and obligate and facultative anaerobes (coliforms; CO-negative). In a field trial, 97.4% of presumptive unsatisfactory samples were verified as being unsatisfactory (having coliform bacteria) by the CO/ONPG test compared to 79.2% by LPW for 1753 colony isolates from 187 chlorinated drinking water supplies. Reduced confirmation with LPW was a result of lack of gas (85.3%) and acid (14.7%) production. 84% of all coliforms were verified within 1 h of subculture using CO/ONPG, compared with 24-48 with the LPW test. All the additional isolates were identified biochemically as Enterobacteriacae of which 78.3% belonged to the accepted coliform genera. (Sand-PTT)
W89-12821

COMPARISON OF MICROBIOLOGICAL DATA FROM TWO WATER FILTRATION PLANTS AND THEIR DISTRIBUTION SYSTEM.
Institut Armand-Frappier, Laval (Quebec).
P. Payment, F. Gamache, and G. Paquette.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 287-289, July 19, 1989. 4 tab.

Descriptors: *Water treatment, *Water conveyance, *Drinking water, *Water distribution, *Water quality, *Viruses, *Bacteria, Coliforms, Aeromonas, Pseudomonas, Clostridium, Vibrio, Chlorination, Public health, Flocculation, Water treatment facilities.

As part of a larger epidemiological study to evaluate drinking water-related health effects, two water filtration and their distribution systems were studied. All samples of raw water contained viruses and indicator bacteria. Treated water at both sites was free of viruses and indicator bacteria as well as other bacteria searched for. The Heterotrophic Plate Count was low in treated water, but many sites in the distribution system were recontaminated by bacteria. Total and stressed coliforms, Aeromonas hydrophila, Pseudomonas aeruginosa and Clostridium perfringens were also detected. The quality of the waters tested was within all accepted standards especially if one considers that all analyses were performed on one liter of water and remained generally negative even for specific bacteria such as P. aeruginosa, A. hydrophila and C. perfringens. In contrast to results obtained a few years ago at these two plants, all samples of finished water were free of viruses. The negative results were due to improvements in the treatment procedures and to physical modifications of these plants, including rebuilding of the plant and the use of chlorine dioxide and optimization of the alum flocculation process. The present study was concerned not only with the elimination of indicator bacteria as well as viral and bacterial pathogens, but also with bacterial regrowth in the system. What was found is consistent with published data: bacterial regrowth can be important in some parts of the distribution system, and many of the bacteria identified in these drinking waters are opportunistic pathogens. The study also demonstrated the presence of a primary emerging pathogen, Vibrio fluvialis, which is now implicated in gastroenteritis. (Author's abstract)
W89-12825

MICROBIOLOGICAL EXAMINATION OF OMI-EBO STREAM AND PIPEBORNE WATER SUPPLY IN ILE-IFE FOR POTABILITY.
Ife Univ. (Nigeria). Dept. of Microbiology.
O. Shonykan, U. A. Adekunle, and N. N. Obiallor.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 303-305, July 19, 1989. 1 tab, 10 ref.

Descriptors: *Developing countries, *Water treatment, *Drinking water, *Water pollution sources, *Water quality, *Bacterial analysis, *Heterotrophic bacteria, Water conveyance, Water quality stand-

ards, Coliforms, Escherichia coli, Clostridium, Nigeria.

The microbiological quality of a surface water source without any form of treatment and that of a selected treated pipe-borne water supply, all used for domestic purposes by the Ile-Ife community in Nigeria, were investigated to present baseline data on potability before the commencement of the new Ede water works. Water samples from Omi-ebo stream were taken from two types of sites: undisturbed surface water and agitated water from the stream edge and areas of decaying organic matter. The total bacterial count and coliform density of the agitated water were higher than those of the undisturbed surface water, indicating that most of the microorganisms are associated with decomposing organic matter. The coliform density and the total bacteria count showed gross fecal contamination of this water source. Isolation of Escherichia coli type I and the presence of Clostridium welchii pointed to recent fecal and remote pollution of this source. The presence of other heterotrophic bacteria with varying pigmentations was noted. The pipe-borne water samples indicated some degree of fecal pollution and did not meet the WHO standards for potable water. The baseline data suggest that the water supply sources to this community do not meet the acceptable standard. Efforts should be made by the local government to facilitate the completion of the Ede water works in order to fulfill the primary health care objective of providing an adequate potable water supply to the Ile-Ife community. (Author's abstract)
W89-12829

THEORETICAL ANALYSIS OF BACKWASH TIME IN RAPID SAND FILTERS.
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-12863

GAS- AND LIQUID-PHASE MASS TRANSFER RESISTANCES OF ORGANIC COMPOUNDS DURING MECHANICAL SURFACE AERATION.
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-12864

POTENTIOMETRIC DETERMINATION OF FLUORIDE AND IODIDE IN NATURAL AND PROCESSED WATERS OF BAHRAIN USING ION-SELECTIVE ELECTRODES.
Bahrain Univ., Manama. Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W89-12871

ASSESSMENT AND MANAGEMENT OF SURFACE WATER QUALITY IN ENGLAND AND WALES.
Water Research Centre, Medmenham (England).
For primary bibliographic entry see Field 5G.
W89-12912

ANALYSIS OF THE LINEAR PROGRAMMING GRADIENT METHOD FOR OPTIMAL DESIGN OF WATER SUPPLY NETWORKS.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
For primary bibliographic entry see Field 8A.
W89-12974

RESISTANCE TO OZONE OF ZOOSPORES OF THE THRAUSTOCHYTRID ABALONE PARASITE, LABYRINTHULOIDES HALIOTIDIS (PROTOZOA: LABYRINTHOMORPHA).
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
S. M. Bower, D. J. Whitaker, and D. Voltolina.
Aquaculture AQCLAL, Vol. 78, No. 2, p 147-152, May 1989. 1 tab, 11 ref.

Descriptors: *Aquaculture, *Abalone, *Parasites, *Fish hatcheries, *Water treatment, *Ozonation, Labyrinthuloides, Protozoa, Zoospores.

Ozone proved ineffective in eliminating the abalone parasite Labyrinthuloides haliotidis from the water supply of an abalone hatchery. Zoospores of the abalone parasite survived exposure to 0.30 mg ozone/l of sea water for 19 min with no apparent detrimental effects. Also, zoospores survived exposure to the highest ozone concentration tested (0.97 mg ozone/L for 25 min) but the treatment appeared to kill or injure some of them judging from the marked delay before growth was observed following transfer to nutrient medium. Zoospores of L. haliotidis also survived long-term (at least 7 days) exposure to low levels of ozone (0.025-0.070 mg/L) in sea water. (Author's abstract)
W89-13006

WATER PRIVATISATION AND THE ENVIRONMENT.
Salford Univ. (England). Environmental Resources Unit.
R. E. Stokes.
Environmental Education & Information EEDIEF, Vol. 8, No. 1, p 42-50, January-March 1989. 3 tab, 9 ref.

Descriptors: *Water industry, *Water conveyance, *Privatization, *Water law, *Water pollution, *Available water, Recreation, Economic aspects, England.

The imminent privatization of the water industry in the United Kingdom causes concern for the environment. The motive for privatization is financial, but the effect of a more commercial regime on water pollution and on land access and use may be adverse. The industry's record in these two areas is discussed. It is and concluded that by the mid-1990s, water pollution will have been reduced, but that the acreage of water industry land available for free public access and recreation will also have decreased. These changes will be due as much to the restructuring of the industry by the Water Bill as to the sale of the water authorities into private ownership. (Author's abstract)
W89-13009

DETERMINANTS OF DRINKING WATER QUALITY IN RURAL NICARAGUA.
Instituto Nicaraguense de Acueductos y Alcantarillados, Managua.
For primary bibliographic entry see Field 5B.
W89-13021

DEGRADATION OF POLYELECTROLYTES IN THE ENVIRONMENT: INSIGHTS PROVIDED BY SIZE EXCLUSION CHROMATOGRAPHY MEASUREMENTS.
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-13062

BACILLUS SUBTILIS/MICROSOME REC-ASSAY FOR THE DETECTION OF DNA DAMAGING SUBSTANCES WHICH MAY OCCUR IN CHLORINATED AND OZONATED WATERS.
Kyoto Univ., Otsu (Japan). Lab. for Control of Environmental Micropollutants.
For primary bibliographic entry see Field 5A.
W89-13064

DEVELOPMENT OF OPERATOR TRAINING IN THE REPUBLIC OF SOUTH AFRICA.
Department of Water Affairs, Pretoria (South Africa).
For primary bibliographic entry see Field 5D.
W89-13078

EVALUATION OF HEURISTIC PROGRAM FOR SCHEDULING TREATMENT PLANT PUMPS.
Centre d'Enseignement et de Recherche pour la Gestion des Ressources Naturelles et l'Environnement, Paris (France).
P. Lannuzel, and L. Ortolano.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 4, p 457-471, July 1989. 2 fig, 3 tab, 5 ref.

Descriptors: *Computer programs, *Expert systems, *Water treatment facilities, *Pumping plants, France, PILOTE Program, Reservoirs, Management planning, Process control, Pumping, Performance evaluation.

PILOTE is a computer program that attempts to reproduce decisions of expert operations who schedule outlet pumps at a water treatment plant near Paris, France. The program integrates both mathematical models and heuristics, i.e., rules-of-thumb used by operators to select configurations of outlet pumps. The models include statistical procedures for predicting hourly water consumption and a hydraulic simulation for estimating hour-by-hour elevation changes at regulating reservoirs and at the elevated reservoir receiving the pumped flows. The heuristics used by operators are based on factors related to water quantity and quality and to operation and maintenance costs. An evaluation of the program showed that the statistical forecasting procedures performed well, but the simulation model consistently overestimated the volumes pumped. The heuristics included in the program accurately represented rules used by expert operators, except for rules used to rank-order alternative pumping strategies. The evaluation provided an agenda of research for refining PILOTE so that it can be used routinely. (Author's abstract)
W89-13126

LEAST-COST DESIGN OF AQUEDUCT SYSTEMS.
Iowa Univ., Iowa City. Inst. for Economic Research.
K. P. Georgakakos, and R. H. Galarraga Sanchez.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 4, p 486-502, July 1989. 10 fig, 5 tab, 10 ref, 2 append.

Descriptors: *Water conveyance, *Aqueducts, *Hydraulic engineering, *Hydraulic design, *Cost analysis, Optimization, Water demand, Water supply, Simulation, Financial planning, Mathematical analysis.

A new approach has been developed to solve the problem of designing an aqueduct system in areas of uniform terrain slope. The approach is based on the premise that, apart from the amount of water to be allocated, the location of the elements of an aqueduct system is a variable to be optimized for a minimum cost design. Based on the geographical distribution of users and individual demands, a function of demand is established to determine the optimal number of laterals. For each number o laterals, and using dynamic programming, the least-cost layout of the aqueduct system is determined. Simulation studies of hypothetical cases show that significant savings can accrue to interest groups financing aqueduct systems through the use of mathematical optimization techniques and that least-cost design depends on the spatial distribution of demand for water. (Author's abstract)
W89-13128

MINIMIZATION OF RAW WATER PUMPING COSTS USING MILP.
Research Triangle Inst., Research Triangle Park, NC.
K. W. Little, and B. J. McCrodden.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 4, p 511-522, July 1989. 1 fig, 1 tab, 12 ref.

Descriptors: *Water treatment, *Pumping, *Cost analysis, *North Carolina, *Optimization, Mixed-integer linear-programming model, Utilities, Energy, Mathematical models, Water supply, Electric, Management planning.

With increasing demands for water, increasing costs for electrical energy, and often stagnant budgets, water utilities must begin to investigate alternative pumping policies that achieve cost savings while not sacrificing system performance. A study was performed for the city of Raleigh, North

Carolina, to determine efficient raw water pumping policies to take advantage of existing storage and newly available time-of-use power rates. The problem was formulated as a mixed-integer linear-programming (MILP) model. Binary integer variables are used to model commercial demand charges, which are once-per-billing period assessments on the maximum on-peak and off-peak electrical demands. Other costs to be minimized include commercial energy charges and standby generator costs to avoid on-peak commercial power use. Constraints include satisfaction of water demands, minimum and maximum reservoir levels, minimum and maximum pump run times, and other constraints to ensure feasibility. The model is now being used by the city of Raleigh to achieve substantial savings. (Author's abstract)
W89-13130

LOW-ENERGY MEMBRANE NANOFILTRATION FOR REMOVAL OF COLOR, ORGANICS AND HARDNESS FROM DRINKING WATER SUPPLIES.
DSS Engineers, Inc., Fort Lauderdale, FL.
B. M. Watson, and C. D. Hornburg.
Desalination DSLNAH, Vol. 72, No. 1/2, p 11-22, Apr/May 1989. 5 fig, 3 tab, 2 ref, append.

Descriptors: *Nanofiltration, *Water softening, *Water supply, *Membrane filters, *Filtration, *Drinking water, *Color removal, *Water treatment, Desalination apparatus, Water pollution control, Chlorinated hydrocarbons, Organic compounds, Membrane processes, Dissolved solids, Hardness, Chemical properties, Physical properties, Ions, Field tests, Aquifers, Chlorination, Water conservation, Florida.

The field of desalination is becoming increasingly more complex and interesting. Because of the number of components which are being considered for regulation and because of the diversity of their physical and chemical properties, their removal presents a formidable challenge to the water treatment/desalination engineer. Recent developments in membrane technology have created a new generation of membranes which are much more cost-competitive for treating water lower in total dissolved solids for removal of specific hazardous organic contaminants. Because of their ability to reject high percentages of many dissolved components, these new membranes offer a single treatment alternative for removing many of these contaminants. They are classified as nanofiltration or ultra-low pressure membranes, typically providing 90-95% rejection of trihalomethane precursors, 85-95% rejection of hardness, and over 70% rejection of monovalent ions when operated at only 70-100 psi driving pressure. Field testing is now under way in Florida, where substantial trihalomethane precursors are found in the shallower aquifers. This new technology should be of particular interest where water resource conservation procedures involve blending of desalted water with untreated groundwater, surface water and/or catchment storage, followed by chlorine disinfection. (Author's abstract)
W89-13138

POLLUTED WATER RENOVATION FOR REUSE: RECENT BIOTECHNOLOGICAL ADVANCES APPLICABLE IN HOT ARID REGIONS.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. of Aquatic Sciences.
For primary bibliographic entry see Field 5D.
W89-13140

SPONTANEOUS ABORTIONS IN RELATION TO CONSUMPTION OF TAP WATER: AN APPLICATION OF METHODS FROM SURVIVAL ANALYSIS TO A PREGNANCY FOLLOW-UP STUDY.
California Dept. of Health Services, Berkeley.
I. Hertz-Picciotto, S. H. Swan, R. R. Neutra, and S. J. Samuels.
American Journal of Epidemiology AJEPAS, Vol. 130, No. 1, p 79-83, July 12, 1989. 1 tab.

Descriptors: *Water pollution effects, *Drinking water, *Risk assessment, *Epidemiology, *Public health, Human pathology, Human population, California.

A previous study of pregnant women whose water supply was potentially contaminated revealed a significant increase in spontaneous abortions among those drinking tap as opposed to bottled water, regardless of exposure to the contamination. The relation between reported prenatal water consumption and risk of spontaneous abortion was therefore analyzed in an independent cohort of pregnancies seen in 1981-1982 at a health maintenance organization in three counties in northern California. The study used a nested case-control design. Since early miscarriages are left-truncated, gestational age at which a pregnancy comes to medical attention may confound results of pregnancy outcomes studies. Risk set analyses were therefore conducted in two stages: (1) the life table-adjusted risk for those drinking mainly bottled water was 8.4%; the risk for those drinking mainly tap water was 12.5%, and (2) the Cox proportional hazards model was used to control for multiple confounders, yielding a hazard ratio for spontaneous abortion of 1.5 (95% confidence interval 1.1-2.0) for consumers of tap water compared with bottled water. Tap water drinkers whose home source of water included groundwater had the greatest risk (13.8) and, after controlling for confounders, their hazard ratio was 1.7. Based on external data from comparable studies, bottled water drinkers appeared to have had unusually low risks, and tap water drinkers who received groundwater may have had slightly high risks. Inconsistencies in the reporting of tap water consumption suggest recall bias. Causal factors could not be ruled out, however, although no reproductive toxins, either biologic or chemical, have yet been identified in the tap water in this area. (Author's abstract)
W89-13172

HANDBOOK OF WATER PURIFICATION.
John Wiley and Sons, New York. Second Edition. 1987. 777p. Edited by Walter Lorch.

Descriptors: *Water treatment, *Ultrafiltration, *Ozonation, *Distillation, *Reverse osmosis, *Desalination, *Handbooks, Separation techniques, Potable water, Raw water, Seawater.

This is the second edition (originally published in 1981) of a guide for the user of purified water. The contributions are from a team of experts who write on topics relating to the purification of water for research, industry, and medicine. The book covers the processes and systems designed to convert potable water to purified water of a predetermined specification. It presents the theory and technology of the available purification processes as well as the essential unit measurements for the expression of raw water characteristics. The book shows the enormous shift in emphasis in water system design with regard to water prescriptions, instruments, and monitors. Treatment processes such as ultrafiltration and ozonation, which are now in wide use, are covered in separate chapters. The roles of distillation and reverse osmosis for sea water desalination are discussed in depth. This book emphasizes the need for team work in water treatment planning between the specialist manufacturer and the water user. (See W89-13209 thru W89-13230) (Hammond-PTT)
W89-13208

HYDROLOGIC CYCLE: TURNOVER, DISTRIBUTION, AND UTILIZATION OF WATER.
Nottingham Univ. (England).
For primary bibliographic entry see Field 2A.
W89-13209

WATER PHYSICS AND CHEMISTRY.
For primary bibliographic entry see Field 2K.
W89-13210

NATURAL WATERS.
University Coll., London (England).
For primary bibliographic entry see Field 2K.
W89-13211

WATER QUALITY CLASSIFICATION.
Cranfield Inst. of Tech. (England).
For primary bibliographic entry see Field 5A.
W89-13212

MEASUREMENT AND CONTROL.
D. Meredith.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 96-169, 7 tab, 43 fig.

Descriptors: *Water quality control, *Water analysis, *Monitoring, *Water treatment, *Sensors, *Flow measurement, *Measuring instruments, Computers, Electrical properties, Optical properties.

This chapter summarizes current knowledge of measuring systems related to quantitative and qualitative techniques applied to water purification. Both closed pipe and open channel flow measurements are discussed. The qualitative measures discussed included electrical and optical sensors. The electrical sensors are divided into the following categories: temperature, conductometric, potentiometric, amperometric, galvanometric, polarographic, and ionization detectors. The optical sensors are divided into colorimetric (spectrophotometric), turbidimetric, ultraviolet spectrophotometric, infrared spectrophotometric, flame photometric, fluorometric, and emission spectroscopy. All of these sensing systems can be used for measurement on discrete samples under laboratory conditions where manual intervention is possible between each analysis. Many techniques can be automated and used online. The introduction of microprocessors into online analyzers has played a major role in improving their reliability, stability, and accuracy. (See also W89-13208) (Hammond-PTT)
W89-13213

REMOVAL OF INSOLUBLE PARTICLES.
D. B. Purchas.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 173-225, 8 tab, 54 fig, 29 ref.

Descriptors: *Water treatment, *Natural waters, *Potable water, *Suspended solids, *Separation techniques, Flotation, Sedimentation, Pretreatment of water, Chemical treatment, Particulate matter.

Production of potable water from natural water is the most widely used application for the technologies used to remove undissolved solids. For the further purification of potable water in research, pharmacy, and industry, the removal of insoluble impurities is an essential phase before or after processes employed for the removal of dissolved solids. This chapter attempts to provide a clear understanding of the nature of undissolved solid particles and the precesses and equipment used to separated them from water. Flotation, sedimentation, and pretreatment chemicals are reviewed from an historical perspective. The fundamental mechanisms (gravitational and filtration) underling the operation of the various types of solid/liquid separation devices also are discussed. (See also W89-13208) (Hammond-PTT)
W89-13214

ION EXCHANGE.
R. Hill, and W. Lorch.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 226-300, 14 tab, 44 fig, 31 ref.

Descriptors: *Water treatment, *Ion exchange, *Solids, *Water treatment facilities, Industrial water, Municipal water, Water softening, Regeneration, Resins, Metals, Economic aspects.

Ion exchange is a process by which one type of an ion contained in water is absorbed into an insoluble solid material and replaced by an equivalent quantity of another ion of the same charge. If a cation resin is used in the hydrogen, rather than sodium, form, metallic salts are converted to the corresponding acids. These can be absorbed by anion exchange resins in the hydroxide form, resulting in

the complete removal of salts from solution. This deionization process can produce water approaching maximum calculated purity. Ion exchange processes also are reversible. When the resin has reached saturation (exhaustion), it is rendered operative again by regeneration. The regenerant used in softening is common salt. For cation regeneration the hydrogen form, hydrochloric or sulfuric acid is used and the anion resin is generally reactivated with caustic soda. Ion exchange is a batch process, consisting of two distinct phases known as the service and regeneration cycles. Ion exchange is the preferred method for upgrading municipal or private water sources in industry, for water softening, for the purification of boiler food, for fossil fuel and nuclear power stations as well as for use in refineries, in chemical manufacture, the paper industry, food and beverages, topping up of secondary batteries, in the pharmaceutical and electronic industries, in horticulture, medicine, research, education and air conditioning. The history and theory of ion exchange are given. Notes on resin selection, plant characteristics and economics also are provided. (See also W89-13208) (Hammond-PTT)
W89-13215

MICROFILTRATION.
B. J. Weissman.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 303-315, 5 tab, 9 fig.

Descriptors: *Water treatment, *Filtration, *Filters, *Separation techniques, Filter cartridges, Potable water, Industrial water, Solids.

A cartridge filter is a cylindrical, replaceable element filter. In water purification, filters are usually disposable, although some can be cleaned. Filter cartridges are produced in a variety of forms. Commercially available cartridges use materials such as cotton, wool, rayon, cellulose, fiberglass, polypropylene, acrylics, nylon, asbestos, cellulose esters, and fluorinated hydrocarbon polymers as the filter medium. Individual cartridges or multiple arrays of cartridges are installed in filter housings. Cartridge filters are suitable for the removal of particulates from pre-treated water in the range from 0.04 to 100 millimicrons, provided the total suspended solids do not exceed 100 ppm. Some corporate and potable water supplies may be passed through cartridge filters without prior treatment. Filter media are replaced when throughput indicates that the pores are blocked. For absolute filtration (total solid particle retention) cartridge filtration is the preferred method. (See also W89-13208) (Hammond-PTT)
W89-13216

REVERSE OSMOSIS.
H. W. Pohland.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 316-372, 7 tab, 42 fig, 60 ref.

Descriptors: *Desalination, *Water treatment, *Water treatment facilities, *Reverse osmosis, *Separation techniques, Membrane filters, Pretreatment of water, Raw water, Seawater, Brackish water, Potable water, Contamination, Economic aspects, Industrial plants, Cost analysis, History, Natural waters, Saline water.

The history and theory of reverse osmosis processes are given, followed by a consideration of energy and cost factors and plant design. Reverse osmosis is a physical process by which the dissolved material in a solvent may be separated from that solvent with the assistance of a semi-permeable membrane. By application of pressure in excess of the natural osmotic pressure to the feedwater the membrane preferentially allows the solvent (i.e. water) molecules to pass through and a high percentage of the electrolytes and dissolved organic materials will be rejected. The raw water is pressure fed into a chamber containing the semi-permeable membrane. Only the pure water (the permeate) can pass through the membrane while the impurities are rejected and turned into waste (the concentrate). Reverse osmosis is operated as a continuous process. Reverse osmosis can reduce the total dissolved solids of the raw water by up to 99 per cent; however, some passage is usually encountered due to the mechanical seals of reverse osmosis devices. After removal of suspended matter and pretreatment based on the raw water analysis, reverse osmosis can upgrade sea water up to 50,000 ppm, brackish water, and saline wells to produce potable water. Reverse osmosis is suitable for producing potable water from raw water containing dissolved minerals salts as well as certain organic impurities. For the purification of tap water with total dissolved solids of 200 ppm or higher, reverse osmosis is the preferred method. In applications where the absence of organisms (biological purity) is vital, as in pharmacy, medicine, and electronic production, reverse osmosis can take the place of distillation with high economy and unprecedented flow speed. Reverse osmosis is the most economical process for saline water treatment to provide potable water. The power needs for reverse osmosis consist chiefly of the energy requirements of the compressor to pressurize the feedwater and the cost of pretreatment chemicals and processes. (See also W89-13208) (Hammond-PTT)
W89-13217

ULTRAFILTRATION.
P. Jordain.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 373-398, 7 tab, 24 fig.

Descriptors: *Water treatment, *Ultrafiltration, *Filtration, *Separation techniques, Membrane filters, Pore size, Particle size, Pyrogens, Chemical properties, Microorganisms.

Ultrafiltration is a low pressure membrane separation process capable of removing high molecular weight dissolved materials, colloids, microorganisms and suspended solids from liquids. Ultrafiltration membranes are manufactured from a wide variety of polymers and mineral materials in the range of 10-200 A. Since the pore sizes of ultrafiltration membranes correspond to very small particles in the colloidal range, it is usual to characterize them by molecular weight cut-off. Typically membranes have nominal cut-offs in the molecular weight range 6000-100,000 and can be characterized using dextrans or polyethylene glycols of known molecular weight fractions. In many applications a gel layer of high molecular weight material forms at the membrane surface producing a 'dynamic membrane'; it is not unusual for high molecular weight cut-off membranes to reject quite small species under such circumstances. Membranes commonly used for water purification include 6000-20,000 molecular weight cut-off for end-polishing and pyrogen removal, and 80,000-100,000 molecular weight cut-off for pretreatment and colloidal removal. Current applications for water purification include removal of colloids from water which would cause serious fouling of other water treatment processes; and removal of microorganisms, pyrogens, and particles from water with hygienically designed modules. (See also W89-13208) (Hammond-PTT)
W89-13218

ELECTRODIALYSIS.
University Coll., London (England).
G. Solt, and P. Foster.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 399-424, 15 fig.

Descriptors: *Desalination, *Water treatment, *Separation techniques, *Membrane processes, *Electrodialysis, *Electrochemistry, Ion exchange, Conductivity, Pretreatment of water, Brackish water, Potable water, Sodium, Sodium chloride, Cost analysis.

Electrodialysis is based on the characteristics of ion selective membranes. These are impervious to water, but allow ions to pass through them in the form of electric current. If a salt solution flows between a pair of anion and cation membranes and an electro motive force EMF is applied across the membranes through the salt solution, the ions will flow out of the water, which is passed on partially desalted. The apparatus consists of a multitude of membranes (the stack) in which the feedwater flows through narrow compartments between cation and anion membranes placed alternately. Two electrodes apply the electron motive force across the stack, causing the sodium ions to move towards the negative electrode and the chloride ions towards the positive electrode. Thus, the water in one compartment will be desalted (diluate) whereas the neighboring compartments will be enriched with ions (concentrate). Alternative compartments produce the diluate (end-product) and the concentrate (waste). Through a collector the diluate is passed to service. Electrodialysis is used in water purification for the desalination of thin brackish water to produce potable water and for pretreatment of feedwater with high total dissolved solids for the ion exchange plant. Electrodialysis can economically reduce the total dissolved solids of the feedwater to 200 ppm, but nonionized impurities or large and immobile ions and colloids are not removed. Brackish water of up to 12,000 ppm can be converted, but feedwater with total dissolved solids of up to 2500 ppm is purified very economically. Power is required in the form of electricity to 'transport' the ions in solution. The amount of current is therefore dependent directly on the total dissolved solids of the feedwater. In cases of high salinity (sea water) electrodialysis is less economical then reverse osmosis or flash distillation, restricting its function in brackish water treatment. (See also W89-13208) (Hammond-PTT)
W89-13219

FRESHWATER DISTILLATION.
L. Saunders, and L. N. Santasalo.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 427-466, 16 tab, 31 fig, 19 ref.

Descriptors: *Desalination, *Water treatment, *Distillation, *Freshwater, Brackish water, Seawater, Injection, Conductivity, Evaporation, Water softening, Pollutants, Chemical properties, Cost analysis.

Water heated to the boiling point is changed into gas, leaving behind the non-volatile impurities. When the gas (water vapor) is cooled, it is changed once more to water, and is now free from dissolved and undissolved non-volatile matter. For distillation, the feedwater enters a boiler and is evaporated. The vapor passes through a cooling chamber where it is condensed to form droplets of pure water that pass to the distillate outlet. All non-volatile substances remain behind in the boiler from where they are removed. Distillation is used for the preparation of purified water for injection in pharmacy, and for production of potable water from sea and brackish water. Distillation is the only water purification process that removes with certainty any organisms (bacteria, viruses and also pyrogens) contained in the feedwater. Theoretically, distillation is capable of removing all non-volatile matter. In practice, however, some carryover of dissolved and colloidal matter into the distillate may take place. Dissolved gases such as carbon dioxide and ammonium can be present in the distillate. End-product purity, expressed in specific conductivity, is between 4.0 and 0.066 microsec/cm at 25 C, depending upon the technique used. Distillation can treat all freshwater, sea and brackish water sources, subject to pretreatment. Scale formation due to hard feedwater should be prevented by softening; silica and metal ions may require ion exchange pretreatment. Two phase changes are inherent in distillation: from liquid to gas and from gas to liquid. First energy is needed to bring the water to boiling point. Second, energy is needed to change the boiling water to gas. Third, a large volume of cooling water is needed for vapor condensation and power is required to circulate the cooling water. These three sets of cost result in high energy consumption. (See also W89-13208) (Hammond-PTT)
W89-13220

SALINE DISTILLATION.
F. C. Wood.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 467-487, 14 fig, 9 ref.

Descriptors: *Desalination, *Saline water, *Distillation, *Evaporators, *Model studies, *Mathematical models, *Water treatment, Flash evaporation, Vapor compression distillation, Salt rejection, Potable water, Seawater, Brines, Cost analysis.

This chapter presents simple mathematical models of the three principal types of saline evaporators: multistage flash, multiple-effect, and vapor recompression. Commercial types of distillation plants for seawater are described, with means of scale suppression, product potabilization, and materials of construction of evaporators. In multistage flash evaporation plants the flash stages are arranged in two groups, i.e., the heat recovery and heat rejection sections. The main flow of seawater discharges back to the heat recovery stage is cooling water; a proportion passes on to the heat recovery section and back through the flash stages via the brine heater. A high proportion of the brine leaving the last heat rejection stage flash chamber is recirculated through the condensers of the heat recovery section. Usually, only 15-20% of this total brine flow is discharged. The objective is to minimize the quantities of chemicals needed for scale control and to increase flexibility of operational control. Multiple-effect evaporation plants rely upon the principle of thin-film evaporation, attaining good heat economy and heat transfer by minimizing hydrostatic head and other parasitic thermodynamic losses during boiling. The seawater and brine are distributed as uniformly as possible in or over tubular arrays of heat transfer surfaces, boiling occurring in thin liquid fills adjacent to the tube walls. By these means, high heat transfer rates and efficient use of the temperature range available between the steam supply and the cooling water can be secured. Vapor recompression evaporation plants, whether mechanically or steam jet-driven, most often are of the thin-film evaporator type. This takes advantage of the low temperature differences which film boiling permits and minimizes compression energy demands. There also are specialized distillation applications, such as dual-purpose (or co-generation) plants. When saline evaporators are used in conjunction with a thermal power plant generating electricity, significant savings of capital and operating costs are possible compared with the production of power and desalted water in separate plants. The most common are conventional multistage flash evaporators using steam extracted from the turbines of steam power plants or from waste heat boilers associated with gas turbines. (See also W89-13208) (Hammond-PTT)
W89-13221

CHEMICAL DISINFECTION.

G. Hooper.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 491-512, 9 tab, 10 fig, 5 ref.

Descriptors: *Water treatment, *Disinfection, *Chemical treatment, *Chemcontrol, *Bactericides, Biocides, Bacteria, Spores, Corrosion, Fouling, Chlorine, Chloramines, Chorine dioxide, Ozone, Bromine, Bromopropionamides, Quaternary ammonium compounds, Chlorinated phenols, Sulfur compounds, Organotin compounds, Formaldehyde, Isothiocyanates.

Chemical disinfection kills or controls the microorganisms in water that can adversely affect its quality, cause fouling or corrosion of equipment, or lead to disease from microbial activity. Disinfection is different from sterilization which destroys all microorganisms. Chemical agents can bring about sterilization but great care must be given to its execution in view of the limitations of chemicals and the diversity of organisms. There are technical as well as health reasons for disinfecting water. For example, Thiobacillus thiooxidans is a bacterium that produces sulfuric acid as it grows; Desulphovibrio spp. produce sulfides and these have caused severe corrosion of steel systems; Pseudomonas spp. can grow on trace levels of organics left in the purified feedwater for high pressure boilers, and this has caused build up of slime causing filter clogging thereby reducing the water supply to process and damaging pumps. Food spoilage is rapid if the water for washing, packing, and cooling is not disinfected or sterilized. To understand the way in which chemicals can control microbial growth it is necessary to understand how they normally grow. At various times and places bacteria have been found growing in temperatures as low as -20 C and as high as 98 C, at pH as low as pH 1, in deserts, in seawater, in ultrapure water, in the complete absence of oxygen or in its presence, and even in the absence of organic carbon. Many bacteria also are capable of surviving by producing spores which are inactive under adverse conditions but capable of germinating when favorable conditions arise. These spores are often totally impervious to antimicrobial chemicals and capable of reinfecting systems once the agent has been removed or the concentration had deteriorated. The chemicals used as antimicrobial agents in water treatment can be split into two broad groups: oxidizing and non-oxidizing agents. Oxidizing biocides include chlorine, chloramines, chlorine dioxide, ozone, bromine, bromamines, and certain organic bromine containing compounds. Non-oxidizing biocides include chemicals such as formaldehyde, isothiocyanates, bromopropionamides, quaternaryammonium compounds, chlorinated phenols, organosulfur, and organotin compounds. (See also W89-13208) (Hammond-PTT)
W89-13222

OZONATION.

Brown, Boveri Research Center, Baden (Switzerland).
For primary bibliographic entry see Field 5D.
W89-13223

ULTRAVIOLET STERILIZATION.

G. O. Schenck.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 530-595, 15 tab, 45 fig, 103 ref.

Descriptors: *Water treatment, *Sterilization, *Ultraviolet radiation, *Water pollution control, *Decontamination, Bactericides, Biocides, Algicides, Bleaching wastes, Clarification, Deodorization, Degradation, Detoxification, Dehalogenation, Flocculation, Irradiation, Oxidation process, Pollutants, Contamination, Microorganisms, Bacteria, Viruses, Hydraulics, Flow pattern, Cost analysis.

Artificial ultraviolet radiation sources can supply bactericidal energy in such a high dosage that in less than a second a higher degree of disinfection is accomplished than by sun irradiation in hours. Bacteria, viruses, phages, and organic micropollutants can be degraded by photochemical wet combustion down to and below detection limits of organic carbon. There are no known ultraviolet-resistant microorganisms. Special effects are obtained by ultraviolet irradiation in the presence of oxygen in addition to disinfection and oxidative degradation: bleaching, decoloration, clarification, deodorization, dehalogenation of C-halogen and N-halogen compounds; detoxification of carcinogens and nerve poisons; flocculation, formation of filtrable precipitates; solubilization, enhancement of biodegradability; decomposition of ozone-resistant heavy-metal complexes photolytic elimination of ozone; improvement of sieve and capillary-passing properties, algicidal and secondary bactericidal actions. There are limitations to ultraviolet treatment which can often be overcome by adequate technical measures. Unlike other water purification processes, ultraviolet irradiation only exterminates living organisms. The radiation must be able to penetrate to the objects of the kill (inactivation); in a dose large enough to kill (inactivate); and long enough to kill and prevent new growth. Contrary to filters, ultraviolet flow-through reactors do not restrict free flow significantly. In contrast to distillation, ultraviolet irradiation imposes no phase changes to the water. Used as a sequence in ultrapure water systems, maintenance requirements are virtually nonexistent; because of the absence of dissolved and particulate matter in purified water, mechanical cleaning of the photoreactor chambers is not essential. The process is highly economical; energy consumption is low and supervision minimal. (See also W89-13208) (Hammond-PTT)
W89-13224

CONVEYANCE AND STORAGE OF PURIFIED WATER.

L. C. Ross.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 599-639, 7 tab, 31 fig, 6 ref.

Descriptors: *Water treatment, *Water conveyance, *Water storage, *Conveyance structures, Decontamination, Flow pattern, Hydraulics, Cost analysis.

Many ways of distributing water have evolved, from open channels, as used in irrigation systems, to large underground passageways. Sometimes water is the conveyor, as in canals, and conveyance can be purely decorative, as in water fountains. The most exclusive way of conveying water is by means of a pipe. In the simplest system the feedwater is purified immediately adjacent to the point of use. The short length of piping required permits a wide selection of materials. In this system the purifier probably is a mixed-bed ion exchange cylinder connected directly to the point of use. Sometimes units are supplied with a filter prior to the treated water outlet. This simple system is often used to upgrade the pre-purified water at the point of use. End-polishing is used where a higher water quality than that of the central distribution system is needed. In a factory distribution system the overall economics of multiple systems with end-polishers are favorable, especially where reverse osmosis is used as the central purification plant. In multiple-loop systems, centrally treated water is supplied to a series of units where there is a requirement for ultra-pure water. Multiple dual-function loops are composite systems where the centrally purified water and ultra-pure water are available side by side at each unit. Provided that the specification of the central water supply is compatible with the process, it can be used sequentially with high economy. In hospitals, research, and industry, purified water is obtained from a centrally located water purification plant if the quantitative requirements make this approach economical. In a typical factory system, a pump draws the purified water from a storage tank and moves it through a mixed-bed polishing column and a two-stage filter stack. After monitoring pressure, resistivity, flow rate, and other parameters, the purified water passes to the factory. Understanding flow balancing is critical to maintaining this type of conveyance system. In storing purified water, atmospheric contamination must be excluded. Airborne particles (microorganisms, spores, and inorganic substances) will reduce water quality. Storage in a sealed container covered with an inert gas such as nitrogen is essential. In less critical applications, filtered air suffices; where the absence of organisms is vital, ultraviolet irradiation should be considered. Flow pattern within the tank also is important. The water should always be in motion and in a good system the stored water is recirculated continually through mixed-bed polishers. (See also W89-13208) (Hammond-PTT)
W89-13225

STERILE AND APYROGENIC WATER.

T. D. Whittet, and P. F. D'Arcy.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 640-692, 4 tab, 6 fig, 124 ref, append.

Descriptors: *Water treatment, *Sterilization, *Apyrogenic water, *History, Standards, Pharmaceutical water, Storage, Pyrogens, Ion exchange, Reverse osmosis, Resins, Chemical properties, Stills, Injection, Reviews.

This chapter reviews the history of sterile and apyrogenic water. The topics discussed include water for pharmaceutical purposes, the history of parenteral therapy, and water as a vehicle for injections. Topics related to pyrogens include the discovery of pyrogens, pyrogenic reactions in humans, and the effect of ion exchange resins on pyrogens, detection and assay of pyrogens, and the limulus amoebocyte lysate test. Topics related to sterilization include a history of the still, reverse osmosis, the preparation of sterile water and water for injections, storage of sterile water, the steriliza-

tion of pyrogen-free water and solutions. Standards for pharmacopoeial purified water and for pharmacopoeial water for injections from the British, European, and United States Pharmacopoeia are included. (See also W89-13208) (Hammond-PTT)
W89-13226

PHARMACY AND MEDICINE.
Cranfield Inst. of Tech. (England).
W. Lorch.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 693-713, 1 tab, 18 fig, 3 ref.

Descriptors: *Sterilization, *Decontamination, *Drugs, Injectables, Water quality control, Contamination, Water softening, Hospitals, Laboratories, Reverse osmosis.

Pharmaceutical manufacturers, hospitals, and medical centers all require purified water of different grades: purified water for injection, purified water for pharmaceutical solutions, for laboratory routine, for critical uses, and water for renal dialysis are examples. Purified water is used in the sterilization centers of hospitals, in the operating theater, for glass washing, and for humidifiers. The trend is for a central system supplying grade 4 water for distribution throughout the complex and providing polishing for specific requirements at the point of use. In hard water areas, a base exchange softener forms part of the installation. Where the feedwater analysis shows a significant organic content the preferred process for central purification is reverse osmosis. (See also W89-13208) (Hammond-PTT)
W89-13227

ELECTRONICS INDUSTRY.
Cranfield Inst. of Tech. (England).
W. Lorch.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 714-738, 13 tab, 9 fig, 10 ref.

Descriptors: *Water treatment, *Water quality control, *Industrial plants, *Electronic equipment, *Decontamination, Contamination, Ultra-pure water, Economic aspects, Heavy metals, Alkali metals, Bacteria, Colloids, Silica.

Ultra-pure water used in the manufacture of printed circuits, semi-conductors, transistors and integrated circuits has one specific purpose, cleaning. The proper function and long-term stability of electronic devices can be improved by intensive cleansing (decontamination) of the active crystal surfaces. The intention is to remove from the crystal the alkali and heavy-metal ions to the limit of detection. Ultra-pure water proved the most efficient medium for this purpose and in this context it may be considered a solvent having a purity of >99.999 per cent. Purified water quality must conform to grade 1. The sources of unacceptable water quality at the point of use are organic contaminants, colloidal silica, bacteria and particulate matter in the system. The study of case histories shows conclusively that the water treatment plant or process were rarely at fault. Production and processing conditions are the main factors in the ultra-water production costs. Potential buyers of an ultra-pure water system should be aware that too restrictive constraints on the initial cost will inevitably sacrifice advantages the could save substantial amounts of money over time. (See also W89-13208) (Hammond-PTT)
W89-13228

BOILER FEED AND CONDENSATE.
Cranfield Inst. of Tech. (England).
W. Lorch.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 739-763, 7 tab, 17 fig, 5 ref.

Descriptors: *Boiler water, *Boiling water reactors, *Water treatment, *Water quality control, *Water reuse, *Scaling, *Corrosion, *Condensates, *Decontamination, Steam, Filtration, Deionization, Dealkalization, Water softening, Cleanup, Contamination, Dissolved solids, Salts, Metal complexes, Chemical sludge.

A boiler water circuit consists of 'make-up water' which is raw water purified to a predetermined degree and 'return' water consisting of steam condensate which is re-used as make-up water. The objective of any feedwater treatment for steam raising boilers is to eliminate the possibility of scale formation, which will interfere with heat transfer, causing wastage of fuel and overheating; and corrosion, which will lead to fuel wastage due to excessive blowdown, and eventually to failure of heating surfaces. The oldest and simplest method of scale prevention is by base exchange softener which will eliminate all but traces of scale-forming salts. These traces may then be maintained in the form of mobile sludge by the addition of a suitable chemical conditioner, easily removed with the normal blowdown water. Dealkalization, deionization, and reverse osmosis also are used to reduce total dissolved solids in make-up water when the condensate can not be recovered and reused as feedwater. In high-pressure steam generators it is desirable to purify 100 per cent condensate flow continuously. The condensate becomes contaminated by corrosion products from the power generating system and by occasional leaks from the cooling water used in the condensers. Much of the contamination is in the form of precipitated metal oxides which must be filtered. The condensate polisher must fulfil two functions: filtration and deionization. Startup of large supercritical boilers using Powdex as the condensate polishing equipment has been successful. The effective removal of contaminants provided very rapid cleanup, permitting faster re-starts of the boiler and turbine. Only minor maintenance problems have been encountered and have not affected the functioning of the Powdex system. Due to the simplicity of the equipment and the fact that the resins are shipped ready for use, a minimum of laboratory and operator attention is required. The backwash requirements of the Powdex process, even under crud conditions of a startup, are substantially less than for comparable polishing equipment. The Powdex process operates in an optimum pH range (9.4-9.6) for corrosion control. The great flexibility of a multi-unit Powdex system can be thoroughly utilized by mixing various proportions of ammonia and hydrogen-form resin to meet the changing condensate conditions that occur during startup. (See also W89-13208) (Hammond-PTT)
W89-13229

FOOD AND DRINK.
Cranfield Inst. of Tech. (England).
W. Lorch.
IN: Handbook of Water Purification. John Wiley & Sons, New York. 1987. p 764-772, 3 tab, 3 fig, 4 ref.

Descriptors: *Water treatment, *Water quality control, *Potable water, *Food processing industry, *Water reuse, *Decontamination, Reverse osmosis, Dealkalization, Deionization, Nitrates, Economic aspects, Water use, Industrial plants.

Food and drink manufacture requires enormous volumes of potable water. For most applications the potable supply has to be further upgraded. Also it is becoming increasingly more difficult and sometimes impossible to obtain such large quantities of water from municipal supplies. Furthermore, wide variations in feedwater quality are unacceptable for the production of canned or frozen food and drinks. The cost of the water itself, purification costs and disposal demand the most stringent management. This chapter provides case histories illustrating the use of reverse osmosis for the production carbonated drinks; nitrate removal by ion exchange; dealkalization for beer production; deionization for whisky production; water re-use in the canning industry; ozone for the treatment of potable water; and the use of these methods for the production of potable water for the preparation of beverages. (See also W89-13208) (Hammond-PTT)
W89-13230

PROCEEDINGS: CONFERENCE ON POINT-OF-USE TREATMENT OF DRINKING WATER.
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-101244. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/9-88/012, June 1988. 146p.

Descriptors: *Drinking water, *Water treatment, *Conferences, Information exchange, Potable water, Education.

The purpose of this conference was to provide information on the application of point-of-use and point-of-entry systems for treating drinking water to a wide-cross section of people interested in this technology. This publication is a compilation of the speakers' papers. The administrative and technical topics covered are regulatory activities, consumer education/protection, treatment, the microbiology of granular activated carbon systems, and system applications. The proceedings conclude with a series of papers prepared by representatives (panel presentation) of the EPA, American Water Works Association, Water Quality Association, and the general public (consumer) who expressed their 'point of view on POU/POE Treatment.' (See W89-13270 thru W89-13294) (Author's abstract)
W89-13269

REGULATORY REQUIREMENTS FOR POINT-OF-USE SYSTEMS.
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
R. Douglas.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 10-11, 1 ref.

Descriptors: *Regulations, *Water treatment, *Filters, Microbiological studies, Standards, Drinking water.

The majority of the water treatment products are registered for use in conjunction with municipally treated or microbiologically potable water. Five of these products are registered for use on untreated or raw water (ie., water of unknown quality or source). Types of registered water treatment products are: water filters, filtering media, replacement cartridges, and water purifiers. Prior to 1979, data requirements for bacteriostatic water filters consisted of bacteriological and chemical data. These data requirements were published as the Interim Requirements for Registration of Bacteriostatic Water Treatment Units for Home Use. In 1984, EPA formed a task force for the specific purpose of developing definitive guidance and specific test parameters for demonstrating effectiveness of water treatment units claiming to microbiologically purify water under conditions that simulated actual use. Current requirements for microbiological water purifiers consist of data showing effectiveness of the product against bacteria, viruses, and protozoan cysts. (See also W89-13269) (Lantz-PTT)
W89-13271

CONTROL OF POINT-OF-USE WATER TREATMENT DEVICES IN CANADA: LEGAL AND PRACTICAL CONSIDERATIONS.
Environmental Health Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 5G.
W89-13272

REGULATION OF WATER TREATMENT DEVICES IN CALIFORNIA.
For primary bibliographic entry see Field 5G.
W89-13273

WISCONSIN REGULATION OF POINT-OF-USE AND POINT-OF-ENTRY WATER TREATMENT DEVICES.
Wisconsin Dept. of Industry, Labor and Human Relations, Madison.
For primary bibliographic entry see Field 5G.
W89-13274

HOUSEHOLD WATER QUALITY EDUCATION: THE COOPERATIVE EXTENSION SYSTEM ROLE.
Kansas State Univ., Manhattan. Cooperative Extension Service.
G. M. Powell.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 22-24, 4 tab.

Descriptors: *Education, *Water quality control, *Kansas, *Public participation, Training, Water quality management.

The extension system is a complex organization of the 50 state Cooperative Extension Services and the USDA, Extention Service. Federal, state, and local sources fund extension programs. The extension system is the noncredit informal education arm of the land-grant universities. It includes substantial professional staff but many volunteer teachers help to make extension a dynamic and important educational tool for adults and youth. Kansas has water quality problems among the 125,000 private water wells that serve 20% of its population. A recent survey found that 37% of the wells, exceeded the maximum contaminant level (MCL) for inorganics, and 10% contained organic contaminants. The Kansas Cooperative Extension Service conducts an educational program on household water quality. It provides information on quality of water from private water wells and in all homes. It includes training of county agricultural, home economics, 4-H and youth agents, and county health services personnel as local sources of information. New extension bulletins and leaflets address water quality, water testing, water treatment, and water quality protection. Other resource materials include video tape and slide/tape sets and new programs. (See also W89-13269) (Lantz-PTT)
W89-13275

FEDERAL TRADE COMMISSION REGULATION OF WATER TREATMENT DEVICES.
Federal Trade Commission, Washington, DC.
For primary bibliographic entry see Field 5G.
W89-13276

NSF'S LISTING PROGRAM FOR POU/POE DWTUS.
National Sanitation Foundation, Ann Arbor, MI.
R. A. Dougherty.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 31-34, 1 fig, 2 tab.

Descriptors: *Water quality standards, *Regulations, *Water treatment, Water quality control, Monitoring, Public participation, Standards, Public health, Drinking water, Organizations.

The National Sanitation Foundation (NSF) was chartered in 1944 in the State of Michigan as a private, independent, not-for-profit organization. The mission of NSF is to develop and administer programs relating to public health and the environment in areas of service, research, and education. NSF is best known for its consensus standards and third-party certification programs. The subject of this article is NSF's listing program for point-of-use and point-of-entry drinking water treatment units (POU/POE DWTUs). The listing programs are voluntary. But a listing program becomes more than voluntary when NSF standards are referenced in regulations or codes. Regulations or codes usually do not require that a product be listed by NSF, but a listed product is usually accepted by the responsible regulatory agency. The key elements of NSF's listing programs (how NSF certifies initial and continuing conformance to NSF standards) are: NSF standards; registered listing marks; public listings information; evaluation and testing by an independent, objective third-party; monitoring; corrective action; and enforcement. By voluntarily participating in the listing program, with required testing, retesting, and unannounced plant inspections by a third-party, a company demonstrates the intent and capability to manufacture a product conforming to an NSF standard. The advantage to a company is wide acceptance of its listed product(s) by regulatory officials and consumers. Regulatory officials and consumers have assurance that a credible, objective third-party, widely recognized by public health officials, has actually tested and verified that listed products comply with specific standards; and the cost of the program is placed in the private sector rather than adding to the cost of official regulation. (See also W89-13269) (Lantz-PTT)
W89-13278

WATER QUALITY ASSOCIATION VOLUNTARY PRODUCT VALIDATION PROGRAM AND VOLUNTARY CERTIFICATION PROGRAM.
Water Quality Association, Lisle, IL.
For primary bibliographic entry see Field 6E.
W89-13279

GUIDE STANDARD AND PROTOCOL FOR TESTING MICROBIOLOGICAL WATER PURIFIERS.
Army Biomedical Research and Development Lab., Fort Detrick, MD.
S. A. Schaub, and C. P. Gerba.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 37-43, 2 fig, 7 tab.

Descriptors: *Water treatment, *Testing procedures, *Microbiological studies, Water quality control, Biological studies, Drinking water, Filtration, Resins, Ultraviolet radiation, Standards.

The Guide Standard and Protocol for Testing Microbiological Water Purifiers provides the water industry, consumers, and government a common approach to the evaluation of existing and developmental products for their microbiological removal capabilities. Presently, the test protocol addresses the following technologies: ceramic filtration candles or units (with or without chemical bacteriostatic agents); halogenated resins and units (with or without filtration capabilities); and ultraviolet (UV) units (with or without filtration and/or chemical adsorption capabilities). The microbiological challenges for testing were chosen to be representative of bacterial, viral, and protozoan pathogens of the gastrointestinal tract, and are believed to cover the treatment requirements presented by most other human pathogens from the gastrointestinal tract or other origins, including fungi and helminths. In addition to the microbiological challenges to the various water purifiers, there was a need to evaluate the treatment capabilities of units in the presence of associated physical/chemical parameters in water, which may impact on the overall microbial removal capabilities of each type of treatment technology. It was decided that for the first half of the testing procedure a general challenge, typical of most tap waters, would be utilized for all testing. The second half of the testing program would use the worst case challenge in which pH, total organic carbon (TOC), turbidity, total dissolved solids (TDS), temperature, and for UV light units, a UV quenching test component, would be added. Additionally, silver leaching test conditions for units containing silver bacteriocide are included. While the standard and testing protocol is rigorous in terms of both microbiological removal requirements and challenge requirements (both microbiological and physical/chemical), it should provide a high degree of confidence in terms of protection to consumers wishing to use point-of-use microbiological water purifications units or devices to remove disease-causing organisms from their drinking water. (See also W89-13269) (Lantz-PTT)
W89-13280

PERFORMANCE AND APPLICATIONS OF GRANULAR ACTIVATED CARBON POINT-OF-USE SYSTEMS.
Amway Corp., Ada, MI. Research and Development Div.
K. Van Dyke, and R. W. Kuennen.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 44-61, 7 fig, 12 tab, 20 ref.

Descriptors: *Granular activated carbon, *Water treatment, *Activated carbon, Drinking water, Volatile organic compounds, Filtration, Trihalomethanes.

Point-of-use (POU) water treatment devices based on granular activated carbon (GAC) have been around for many years. POU filters offer options of technology that could be prohibitively expensive on a large scale. They offer a means to achieve filtration if properly designed to remove even low micrograms/L (ppb) levels of contaminants that are below maximum contaminant levels (MCLs). POU devices containing GAC are designed in one of three basic configurations: GAC in single or sequential housings, GAC and PAC in sequential housing, and pressed carbon blocks. They may be installed in several configurations including faucet, stationary, faucet diverter, and line bypass. This paper summarizes results of laboratory and field studies on POU devices to support the concept of using chloroform as a surrogate compound for making removal claims for specific volatile organic compounds (VOCs) found in drinking water. Results indicate that: a properly designed POU can be effective in removing the regulated VOCs to below the MCL concentrations for a significant period; the removal for the trihalomethanes (THMs), in particular chloroform, provides assurance that the other VOCs can be removed as well; isotherm capacities can predict relative breakthrough orders for the VOCs; testing with a surrogate, eg, chloroform, provides a conservative capacity value for the other VOCs; temperature is an important parameter in POU testing; and selection of GAC and unit design is important. (See also W89-13269) (Lantz-PTT)
W89-13281

PERFORMANCE AND APPLICATION OF RO SYSTEMS.
Desalination Systems, Inc., Escondido, CA.
D. T. Bray.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 62-68, 10 fig.

Descriptors: *Water treatment, *Reverse osmosis, Membranes, Cellulose acetate membranes, Membrane filters, Performance evaluation, Hydrogen ion concentration, Temperature effects, Microbiological studies.

Reverse osmosis (RO), point-of-use (POU) is a relatively old concept--it has been in use for 20 years. There are around 500,000 units in use in the U.S. today. There are three types of RO-POU systems in use today: UTC--under the counter; OTC--over the counter; and OU--office unit. Two types of membranes on the market today, account for essentially all the membranes used in RO-POU units. These are the cellulose acetate (CA) types and the thin film membrane (TFM) polyamide types. The advantages of the CA types include: low cost and good ionic rejection. The disadvantages of the CA types include: pH range limited to 3-8, temperature limited to < or = to 100 F, subject to bacteria attack, and only fair organic rejection. The advantages of the TFM types include: high flows, high rejections, wide pH range (4-11), high temperature (120 F), and bacteria resistant. Disadvantages of the TFM types include: more expensive, needs carbon prefilter, and a tendency to foul. (See also W89-13269) (Lantz-PTT)
W89-13282

PERFORMANCE AND APPLICATION OF ULTRAVIOLET LIGHT SYSTEMS.
Ideal Horizons, Inc., Rutland, VT.
C. Foust.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 69-70.

Descriptors: *Disinfection, *Water treatment, *Ultraviolet radiation, Performance evaluation, Drinking water, Maintenance, Microbiological studies, Protozoa, Bacteria.

The increasing demand for high quality water, combined with the reduction in quality of available water sources, has caused an upsurge in water

treatment technology. The effectiveness of ultraviolet (UV) as a preferential microbiological treatment should be evident in its choice as the disinfectant in over 2,000 cities in Europe. UV light accomplishes this without using harmful chemicals, some of which when used can lead to the formation of harmful secondary chemical products, such as trihalomethanes (THMs). Most common pathogenic microorganisms have been tested for their sensitivity to UV light, and the results have been published in various publications. E coli will be reduced to a 0.0001 survival ratio, if treated in most commercially available units. Giardia lamblia has a survival ratio of 0.1 with twice the treatment available in most commercial units. The recommended dosage of UV is at least 16,000 microwatts/sec/sq cm. Presently, most manufacturers treat with a dosage of 30 to 35,000 microwatts/sec/sq cm. These dosage rates are capable of a four-log reduction, which means that incoming water would be effectively 99.99% treated. Application of the available technology is quite simple and easily quantified. Start-up and maintenance of these units is quite simple. After installation and any breach of the system, the downstream piping should be sterilized. Normally the unit requires annual servicing, which consists of cleaning the parts and replacing the bulb. (See also W89-13269) (Lantz-PTT)
W89-13283

PRECOAT CARBON FILTERS AS BARRIERS TO INCIDENTAL MICROBIAL CONTAMINATION.
Everpure, Inc., Westmont, IL.
P. Regunathan, W. H. Beauman, and D. J. Jarog.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 71-80, 15 fig, 9 tab, 14 ref.

Descriptors: *Carbon filters, *Microbiological studies, *Water treatment, *Filtration, *Activated carbon, Contamination, Silver, Viruses, Protozoa, Bacteria.

The microbiological characteristics of point-of-use (POU) filters have been a source of concern in the minds of many in the regulatory, utility, and academic fields. These concerns have centered around the possible growth of bacteria in various POU devices, particularly carbon filters, and the probable effect of such growths on the health of the consuming public. This study investigates the role of a POU precoat carbon filter as a final barrier to microbial contamination that may otherwise inadvertently reach the consumer. POU precoat filters belong to a family of POU fine-filtering devices that includes, besides precoat filters, carbon block filters made from powdered carbon, ceramic filters manufactured with controlled fine pores, pleated membrane filters with absolute ratings, and reverse osmosis membrane systems. All these devices are usually rated as capable of filtering down to 1 microgram or less. Data presented show significant and consistent reductions by these precoat filters of coliforms (about 99%), enteric viruses (about 99%), and protozoan cyst/surrogates (> 99.9%). Silver in precoat carbon filters lowers coliform levels at least 1 log more than the standard precoat filters. The decision to use R2A agar at 25 to 28 C for seven day incubation procedures instead of SPC agar pour plates at 25 C for two days is not trivial. Not only does the new HPC procedure yield 1/2 to 1-1/2 logs higher counts, it also favors a different population, leading to different overall conclusions. Silver appears to effectively control the filter effluent HPC levels that are found growing in R2A media incubated at 25 to 28 C. Proper comparisons of all data indicated silver as bacteriostatic in precoat carbon filters. Precoat filters with or without silver appear to act as barriers to incidental microbial contamination because they do confer some measurable microbial contamination of potable water supplies that are normally safe. (See also W89-13269) (Lantz-PTT)
W89-13284

MICROBIOLOGICAL STUDIES OF GRANULAR ACTIVATED CARBON POINT-OF-USE SYSTEMS.
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
D. J. Reasoner.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 81-83, 2 ref.

Descriptors: *Activated carbon, *Adsorption, *Water treatment, *Granular activated carbon, *Microbiological studies, *Filtration, Bacteria, Public health, Organic carbon, Chloroform.

Activated carbon, powdered (PAC) or granular (GAC), has been used in water treatment for many years, primarily to remove tastes and odors. An aspect of GAC POU treatment devices that has been of concern to the Drinking Water Research Division of the US EPA in Cincinnati, is the long-term microbiological quality of the product water from such devices. The first phase of studies on the microbiological characteristics of carbon POU filters was begun in 1977. This phase examined four carbon POU filters for variations in bacterial counts, heterotrophic plate count (HPC), total organic carbon (TOC), and chloroform (CHCl3) levels. In addition, one filter was installed on a low-flow drinking water fountain, and bacteriological quality and THM content of the product water were monitored weekly. HPC levels in the effluents from the carbon filters were always higher than the bacterial levels of the influent tap water. Total organic carbon removal appeared to be minimal because influent TOC levels were always < 2 mg/L (2 ppm) and effluent levels were within 0.1 to 0.3 mg/L of the influent levels one day after installation. The initial percentage removal of CHCl3 ranged from 100% down to about 55%, and decreased with time over a period of 20 weeks. By the end of the 20-week test period, effluent CHCl3 concentrations for three of the test filters exceeded influent CHCL3 concentration, while the fourth filter unit was still removing about 20% of the influent CHCL3. The second phase examined four additional GAC POU filters designed to be installed as stationary filters under a kitchen sink on the cold water line to a common mixing faucet. Variations in HPC levels in the product water between morning and afternoon samples from the lost filters were similar to found during the first phase study. Additionally, it was shown that stagnation periods from several hours to several weeks resulted. The third phase of the GAC POU study, currently nearing completion, was designed to examine GAC POU treatment units intended to be installed as third-faucet units, treating only water for drinking and cooking, not all of the water going to the main kitchen faucet. The general implications of the studies conducted are that all GAC POU devices become generators of bacteria due to the large surface area exposed to the water, and due to adsorption of nutrients from the water that bacteria are able to use for growth. However, the potential for adverse human health effects from ingestion of large numbers of HPC bacteria in water appears to be low. (See also W89-13269) (Lantz-PTT)
W89-13285

HEALTH STUDIES OF AEROBIC HETEROTROPHIC BACTERIA COLONIZING GRANULAR ACTIVATED CARBON SYSTEMS.
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
A. D. Dufour.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 84-87, 3 tab, 12 ref.

Descriptors: *Aerobic bacteria, *Granular activated carbon, *Water treatment, *Activated carbon, *Public health, *Filtration, Bacteria, Contamination, Microbiological studies, Drinking water, Heterotrophic bacteria.

Aerobic heterotrophic bacteria are ubiquitous in the aquatic environment. These bacteria occur in drinking water at densities as high as several hundred thousand per milliliter in some cases, and they provide a constant seed for devices used to treat potable water at its point-of-use (POU). Granular activated carbon (GAC) filters, in this regard, are of special interest because of their increased use by the general population and because they have the capacity to adsorb bacteria from water. Once adsorbed on the GAC filter, the bacteria are able to multiply to even higher densities than observed in the influent water and they, in turn, slough off into the effluent water. Gram negative bacteria are predominant, just as in the water distribution systems. An epidemiological study conducted by Yale University was supported by the EPA in order to determine if adverse health effects are associated with GAC filter use. Two types of filters were used in the study. One was a faucet-type filter that attaches to the tap with a special adapter. The filter was activated by turning a valve that directed the water through the GAC bed. The second type of filter was a bypass-type that tapped directly to the cold water line and delivered the water through a separate tap attached to the sink. One interesting results of the monitoring was the high initial densities of heterotrophs observed in the water samples taken from the faucet filter housing units without carbon. The greatest exposure to heterotrophic bacteria occurred with the bypass filters. The exposure to heterotrophic bacteria was, on the average, about 20 times greater for bypass-filter users than for control groups exposed to heterotrophic bacteria in unfiltered tap water. The faucet-type filter effluents contained about 12 times more heterotrophs than were found in the tap water. However, the heterotrophic bacterial densities in the bypass and faucet-filter effluents exceeded that of the blank filter housing units by factors of only six and four, respectively. Thus, the exposure differences were not as great when the faucet housing only group was used as a control population, as was the case in this study. The means of the heterotroph densities of both the faucet-type and bypass-type filters were statistically significant from the mean density of heterotrophs observed in the blank housing unit effluents. (See also W89-13269) (Lantz-PTT)
W89-13286

ACTIVATED ALUMINA FOR POU/POE REMOVAL OF FLUORIDE AND ARSENIC.
Water Treatment Engineers, Scottsdale, AZ.
R. L. Lake.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 88-89, 8 ref.

Descriptors: *Arsenic, *Fluorides, *Water treatment, *Alumina, Drinking water, Hydrogen ion concentration, Chemical reactions, Filtration, Ion exchange.

For the past 144 years, point-of-use (POU)/point-of-entry (POE) applications have been treating high fluoride and/or arsenic water with activated alumina (AA). Each AA system may require a different approach with respect to installation, monitoring, and servicing. To monitor fluoride reduction systems, a spectrophotometer and SPADNS reagent are used, which is simple, inexpensive, and can be performed in the field. Arsenic has no simple field test, but fortunately all tested, arsenic-bearing waters also contain fluoride. Since fluoride breakthrough occurs before arsenic, testing for fluoride can exchange units before arsenic breakthrough. Activated alumina is primarily a hydrated aluminum oxide (Al_2O_3), which has been heated to a temperature of 300 to 700 C. AA is an ion exchanger with the capacity of exchanging both anions and cations. Activated alumina such as ALCOA F-1 or Kaiser Chemical A-2 should be pretreated before incorporation into a POU system. Pretreatment consists of a thorough backwash and acid wash. Aqueous state AA will have a pH of 9 to 10 and should be acid washed with a pH 2 sulfuric acid solution to a pH of 5 to 6. Backwashing is essential to remove the dust and fines in the material. A regeneration method that gives uniformly good results has been recently developed. The process entails allowing complete replacement of the sorbate F(-), AsO4(-3), etc., with OH(-) and complete neutralization of the basic state AA with acid. Both of these reactions are time dependent, and allowing sufficient time for completion is the key to the success of this method. The steps in regeneration are: (1) backwash; (2) upflow regeneration; (3) soak; (4) neutralization; (5) soak; and (6) final backwash and refill. This

study illustrates that POU treatment is a cost effective method of treatment in situations where the cost of central treatment would be prohibitive. (See also W89-13269) (Lantz-PTT)
W89-13287

MODELLING POINT-OF-ENTRY RADON REMOVAL BY GAC.
Maine Univ., Orono.
J. D. Lowry, and S. B. Lowry.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 90-98, 7 fig, 3 tab, 28 ref. EPA Grant R8108290.

Descriptors: *Activated carbon, *Granular activated carbon, *Radon, *Water treatment, *Filtration, Adsorption, Drinking water, Public health, Model studies.

A first order model accurately describes the adsorption/decay steady state removal of 222-Radon (222-Rn) by granular activated carbon (GAC). A single design constant, K sub ss, can be used to rank a given GAC type of 222-Rn removal. The ranking of a carbon for steady state performance does not appear to be related to its ranking according to an adsorption isotherm. There is a significant range of the design constant, K sub ss, for the carbons tested to date, making the selection of the correct GAC important. This is especially true for small public water supply applications, where economics are more sensitive to vessel size. More than 99% reduction of 222-Rn is possible with an effective GAC. The progeny of 222-Rn make it important to consider the location of and protective shielding for a GAC bed, to minimize increased gamma exposure over background levels. Limited data indicate a possible premature fouling of approximately 3-5% of existing GAC units. The reason for this decreased removal in these installations is unknown and should be investigated. (See also W89-13269) (Lantz-PTT)
W89-13288

POINT-OF-ENTRY ACTIVATED CARBON TREATMENT LAKE CARMEL--PUTNAM COUNTY.
New York State Dept. of Health, Albany. Bureau of Public Water Supply Protection.
G. A. Stasko.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 99-105, 2 fig, 8 tab.

Descriptors: *Water treatment, *Lake Carmel, *Activated carbon, *Filtration, Costs, New York, Bacteria, Organic compounds, Inorganic compounds, Drinking water, Public health.

Lake Carmel is a small lake located about 80 km north of New York City. In the 1970s, some of the residents complained about petroleum odors in their water. The residents believed that the groundwater was contaminated from a petroleum spill or from a waste site. However, as a result of investigations, it was concluded that the residents had contaminated their own water supplies by localized petroleum leaks and spills, and by the chemicals flushed into their septic systems. Water quality analyses of the water, with respect to bacterial contamination, organic chemicals, and inorganic chemicals, further indicated that water treatment was needed. The health department worked closely with consultants to develop a water treatment system that would adequately treat the water and would satisfy all regulatory concerns. The treatment system consists of: a raw water tap located immediately after the homeowner's pressure tank used to collect untreated water samples; two 5-micrometer cartridge-type prefilters in parallel to prevent the activated carbon filters from clogging due to particulate matter; two activated carbon filters in series; a valving arrangement is provided to allow for water use during the cylinder changing procedure; pressure gauges are provided before and after the treatment system to determine head loss across the system; and ultraviolet light disinfection is provided after the activated carbon units to destroy bacteria that break through the filter system. For the first four years of operation, the annual cost for operation, maintenance, and monitoring has been $250 per treatment system. The annual charge has recently been raised to $320 per year aid on a quarterly basis. This amounts to a total annual budget of $20,480 for the district. The system appears to be performing satisfactorily. (See also W89-13269) (Lantz-PTT)
W89-13289

COMMUNITY DEMONSTRATION OF POU SYSTEMS REMOVAL OF ARSENIC AND FLUORIDE: SAN YSIDRO, NEW MEXICO.
Leedshill-Herkenhoff, Inc., Albuquerque, NM.
K. Rogers.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 106-110, 1 tab.

Descriptors: *Reverse osmosis, *Water treatment, *Arsenic, *Fluorides, San Ysidro, New Mexico, Economic aspects, Water quality, Drinking water, Public health, Monitoring.

San Ysidro is a small, rural village of approximately 200 people located in the north central part of the State of New Mexico, approximately 50 minutes north of Albuquerque. The village water supply is collected in an infiltration gallery into which groundwater is drawn. This local groundwater contains leachate from geothermal activity in the area's abundant mineral deposits and is therefore high in mineral content. The groundwater exceeds the standards and/or maximum contaminant levels (MCLs) for arsenic, fluoride, iron, manganese, chloride, and total dissolved solids. A number of alternatives have recently been investigated by engineers to aid the village in obtaining a higher quantity and quality of water. When the village first was found to be in violation of the Safe Drinking Water Act (SDWA) for levels of arsenic and fluoride in the water supply, four deep test wells were drilled to determine if there was a better source of water available. The best of those wells only had water equal in quality to the water inn the infiltration gallery. A variance from the SDWA for arsenic and fluoride was granted to the village while research was performed to determine an economical and effective solution to the contaminant problem. The treatment systems studied were activated alumina and reverse osmosis (RO). Central and point-of-use (POU) treatment were considered. Central treatment of the entire water supply was not considered feasible for many reasons. Since arsenic and fluoride are only considered harmful in water used for human consumption, a POU unit for treatment was needed for only water used for drinking and cooking. Many factors made the decision to try POU units in the individual homes a fairly easy one. Once it was determined that POU RO might be a good solution for the village, an ordinance was passed by the village which made the use of village water contingent upon installation of the RO unit in the home. Currently, 70 units are available for testing on this project. There are a few units in unoccupied homes which the village has been reluctant to take the initiative to remove. The 70 units are tested every other month for arsenic and fluoride and approximately every three to four months for chloride, iron, and manganese. Disadvantages of the project include: high sampling costs; training must be conducted for new members of the community; and, do-it-yourself plumbers. Advantages include: aesthetic water improvement; ease of installation; and, least expensive alternative. (See also W89-13269) (Lantz-PTT)
W89-13290

FLORIDA'S FUNDING FOR CONTAMINATION CORRECTION.
Florida State Dept. of Environmental Regulation, Tallahassee.
G. Dykes.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 111-112.

Descriptors: *Activated carbon, *Filtration, *Cost analysis, *Florida, *Water treatment, *Granular activated carbon, Water quality, Drinking water, Ethylene dibromide, Drinking water, Organic compounds, Benzene, Hydrocarbons.

Carbon filtration has been found to be a satisfactory method of removing ethylene dibromide from contaminated supplies. The Florida Department of Environmental Regulation (FDER) is also utilizing granular activated carbon (GAC) filters in correcting contamination problems created by leaking underground petroleum storage tanks. Current testing indicates that GAC will remove benzene and other hydrocarbons and thereby solve some of the problems related to these contaminants. The use of point-of-entry (POE) solutions must consider the long-term cost in considering the economic viability. The cost must be given a thorough evaluation before determining that POE devices are to be placed on all residences in a community. It is always gratifying when a permanent solution can be found and the utility does not have to worry about the maintenance problems that always seem to plague these small installations. The present projected cost of $12,000 per house with a Type I connection would go a long way to provide a central system for the whole community. (See also W89-13269) (Lantz-PTT)
W89-13291

MONITORING AND MAINTENANCE PROGRAMS FOR POU/POE.
National Sanitation Foundation, Ann Arbor, MI.
G. E. Bellen, and T. G. Stevens.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 113-117, 5 tab, 15 ref.

Descriptors: *Water quality management, *Management planning, *Water treatment, Monitoring, Water quality control.

Providing water to consumers that meets the US EPA National Primary Drinking Water Regulations system organization, maintenance, and monitoring. This is true whether central, point-of-use (POU), or point-of-entry (POE) treatment is used. The goals for protection of health are the same regardless of the method used to attain the goals. While POU and POE technologies are not recognized as best available technologies in the regulations, they are considered to be acceptable for use if specified conditions of system control, monitoring, effectiveness, and public health protection are assured. Effective and reasonable monitoring and maintenance programs can be developed to meet the requirements of the regulations, whether within an existing water system organization or by means of an organization established specifically for operation and maintenance of POU/POE systems. For water treatment professionals with experience only in central treatment, it may, at first, seem extremely difficult to achieve comparable health protection with POU or POE devices. However, as experience is gained with new approaches to community treatment, POU or POE water treatment districts may offer attractive benefits for some communities. (See also W89-13269) (Lantz-PTT)
W89-13292

POINT-OF-USE AND POINT-OF-ENTRY TREATMENT DEVICES USED AT SUPERFUND SITES TO REMEDIATE CONTAMINATED DRINKING WATER.
Environmental Protection Agency, Chicago, IL. Region V.
S. L. Bianchin.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 118-128, 5 fig.

Descriptors: *Water quality control, *Water treatment, *Drinking water, *Management planning, Water pollution treatment, Case studies, Illinois, Indiana, Water quality management, Superfund, Regulations.

Hazardous waste is one of this nation's greatest concerns. In response to that concern. This law is the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), referred to as the Superfund Law was enacted to deal with the hazardous waste problem. Over two-thirds of the Superfund actions to date, deal with a

contaminated drinking water supply. Where the Safe Drinking Water Act (SDWA) Standards are applicable to the Superfund cleanup, maximum contaminant levels (MCLs) are usually used. After a site is included on the National Priority List (NPL) of Superfund, a remedial action is planned. As a short-term response to alleviate the immediate danger of contaminated drinking water, bottled water is routinely utilized. This type of response is most often used in a removal action. In the interim, the following are commonly considered alternative where drinking water is a concern: providing bottled water; provide alternative water; installation of point-of-use (POU) treatment devices; and installation of point-of-entry (POE) treatment devices. As a longer term response, or as a permanent remedy, the following are commonly considered remedial alternatives for a contaminated drinking water supply: connecting to a community water system; provide a new water source (well or surface); and maintaining individual treatment unit previously installed. Two case studies which utilize both the short-term and long-term responses to drinking water problems are presented. The first case discussed is the Byron Johnson Salvage yard in Byron, IL, and the second is the Main Street Well Field and associated actions in Elkhart, IN. The geohydrology of each site is discussed, followed by in-depth time tables of the actions and alternatives, studied and applied, at each site. (See also W89-13269) (Lantz-PTT)
W89-13293

NEW DEVELOPMENTS IN POINT-OF-USE/POINT-OF-ENTRY DRINKING WATER TREATMENT.
Ametek, Inc., Sheboygan, WI.
G. L. Hatch.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 129-135, 4 fig, 4 tab, 26 ref.

Descriptors: *Ion exchange, *Drinking water, *Water treatment, *Halogenated resins, Resins, Performance evaluation, Halogens, Disinfection, Water quality.

All areas of point-of-use/point-of-entry (POU/POE) water treatment technology are advancing rapidly. Much of this technology is based on newly engineered systems, which by redesigning existing or well known technologies, can solve almost any water contamination problem. Use of halogenated resins in POU water disinfection can offer a unique opportunity to help solve some of the current problems associated with conventional small-scale chlorination disinfection systems. Some advantages are: no electrical connections (depending on monitoring requirements); easy to install and service--no handling or storage of chemicals; virtually no 'down' time; minimal space requirements; more efficient use of disinfectant; and potential to integrate well with other POU technology. However, even though these resins have remarkable disinfecting capabilities, proper design, thorough testing, and prudent application are absolutely necessary to assure maximum reliability of system in which they are used. Currently available POU water treatment technology can be properly combined with halogenated resins to offer another alternative for providing microbiologically safe drinking water. (See also W89-13269) (Lantz-PTT)
W89-13294

WATER PURIFICATION AND WASTE CONCENTRATION BY THE VACUUM FREEZING MULTIPLE PHASE TRANSFORMATION PROCESS AND ITS EUTECTIC EXTENSION.
Calyxes Research and Development Corp., Albuquerque, NM.
For primary bibliographic entry see Field 3A.
W89-13383

5G. Water Quality Control

FINITE ELEMENT ANALYSIS OF CONTROLLED SALTWATER INTRUSION IN HETEROGENEOUS RESERVOIRS.
Tage Sorensen, Consulting Engineers Ltd.
For primary bibliographic entry see Field 2F.
W89-12196

MANAGEMENT OF WATER QUALITY IN THE GREAT BARRIER REEF MARINE PARK.
Great Barrier Reef Marine Park Authority, Townsville (Australia).
S. Woodley.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 31-38, 1989.

Descriptors: *Water pollution prevention, *Great Barrier Reef, *Tourism, *Water quality management, *Water pollution sources, *Australia, Wastewater disposal, Nutrients, Oil spills, Litter, Sedimentation, Antifouling compounds, Zoning.

In recent years the effects of chronic pollution on coral reefs has become more widely known and the need for preventative action more pressing. Public concern about pollution effects on the Great Barrier Reef has grown with increasing tourism. The Great Barrier Reef Marine Park Authority was established in 1975 as the principal agency responsible for management of the Park. The functions of the Authority are: to make recommendations in relation to the care and development of the Park; to carry out and arrange for other persons or institutions to carry out research and investigations relevant to the Park; to prepare zoning plans; to provide, and arrange for, the provision of educational, advisory, and informational services relating to the Park; and to furnish advice and information on matters relating to the Park, including agreements and financial arrangements between the Commonwealth and Queensland. The main water quality issues which affect or might affect the management of the Park include sewage discharge, nutrients, toxic contaminants, oil spills, litter and marine debris, sedimentation, and antifouling. The Authority has to ensure that the physical environmental effects of such discharges are kept within acceptable limits and has to satisfy public perceptions of apparent impacts on water quality. (Author's abstract)
W89-12206

MERCURY FIXATION IN CONTAMINATED SEDIMENTS AS A MANAGEMENT OPTION AT ALBANY, WESTERN AUSTRALIA.
Western Australia Chemistry Centre, Perth. Water Science Lab.
R. S. Schulz.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 45-51, 1989. 3 fig, 3 tab, 16 ref.

Descriptors: *Water pollution treatment, *Sediments, *Mercury, *Iron, *Australia, Water management, Sea grasses, Princess Royal Harbor.

Water overlying mercury contaminated sediments in Princess Royal Harbor, Albany, was found to contain up to 0.8 microgram/L of Hg. Using contaminated sediments and water from Princess Royal Harbor, experiments were carried out to remove the Hg from the waterbody and fix it to the sediment. Treatment with metallic Fe reduced the Hg concentration of the water to less than 0.1 microgram/L within 2 minutes and any potential visual pollution from the oxidation of Fe was prevented by a sand overlay. The sand did not interfere with the lasting effectiveness of the Fe. A field trial was conducted to test the system under wind and tidal conditions in shallow waters of Princess Royal Harbour. It was established that due to the sedimental rework, the overlay thickness would have to be increased for the shallow waters. For deeper waters (>2 m), the system is expected to give good results over sand bottoms. Seagrass covered areas are expected to yield staining problems due to ineffective sand overlay. (Author's abstract)
W89-12208

WATER QUALITY IN RESIDENTIAL TIDAL CANALS.
Queensland Dept. of Environment, Conservation and Tourism, Brisbane (Australia). Div. of Water Quality.
For primary bibliographic entry see Field 5B.
W89-12209

SETTING AND ACHIEVING WATER QUALITY CRITERIA FOR RECREATION.
Gutteridge, Haskins and Davey, Melbourne (Australia).
J. A. Crockett, K. J. Hartley, and W. D. Williams.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 71-76, 1989. 1 tab.

Descriptors: *Water quality control, *Recreation, *Water quality, *Artificial lakes, *Canals, *Water management, Reviews, Marinas, Australia.

Water-based recreation is popular in Australia. On the coast many canal estates and marinas are being constructed. Australia's arid and variable climate introduces unusual problems in the establishment of inland recreational lakes. In setting water quality criteria what is achievable must be balanced with what is desirable and criteria may need to be varied between flood and dry periods. Greater emphasis should be placed on understanding, monitoring and managing the ecology of water-bodies. If a stable ecology is maintained, it will generally follow that water quality and conditions surrounding the water-body will be acceptable for human use. In designing man-made inland lakes for recreational use in Australia the following factors must be considered: (1) impact on local flora and fauna; (2) development of aquatic weeds; (3) suitable fish species; (4) noxious vertebrates; (5) birds, which have been implicated as reservoirs for viruses which affect humans; (6) arboviruses, transmitted to man by arthropod vectors, usually mosquitoes; (7) nuisance insects; (8) bathers itch; and (9) algal growth problems. In developing new lakes and canals mathematical modelling must be carried out to provide a rational basis for determining water quality criteria and the necessary management actions. (Sand-PTT)
W89-12212

MANAGEMENT OF RECREATIONAL WATER QUALITY IN ESTUARIES AND COASTAL WATERS: AN INTEGRATED STUDY.
Water Research Centre, Medmenham (England). Medmenham Lab.
D. Fiddes, and T. J. Lack.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 83-92, 1989. 3 fig, 4 ref, 2 append.

Descriptors: *Wastewater disposal, *Estuaries, *Coastal waters, *Recreation, *Water pollution sources, *Water quality standards, *Water pollution prevention, Wastewater outfall, Storm wastewater, Wastewater treatment facilities, Modeling studies, Swimming, England.

Major programs are being undertaken in UK coastal areas to reduce the environmental impact of sewage discharges to estuarine and coastal waters. A particular requirement is compliance with the European Communities Bathing Water Directive. Experience has shown that cost-effective environmentally acceptable schemes can be designed incorporating long sea outfalls but only if all major sources of pollution loading are considered concurrently and sewer, river and marine modelling techniques and standards harmonized. To develop this integrated approach, the UK Water Industry has mounted a major research program. The resulting procedure is outlined in a flow chart and the concept of use areas and associated quality standards introduced. The need for regular performance monitoring of outfalls is stressed. A principal source of pollutants is the re-entrainment of sewer sediments. The results of the modelling studies have generally pointed to the need for remedial works within the body of the sewage system to attenuate storm sewer overflows and the resulting pollution and improvement in the effluent quality of inland sewage treatment facilities. (Sand-PTT)
W89-12214

LAKE TINAROO (AUSTRALIA): TOWARDS A MANAGEMENT PLAN.
Queensland Water Resources Commission, Mareeba (Australia). Far Northern Regional Office.
W. D. Souter, and J. D. Flanders.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 99-104, 1989. 1 fig.

Descriptors: *Water quality management, *Lakes, *Catchment areas, *Recreation, *Tourism, *Irrigation, *Management planning, *Nutrients, *Australia, Agriculture, Crops, Lake Tinaroo.

Tinaroo Falls Dam provides a water supply for irrigated agricultural production, primarily tobacco, rice, tree and horticultural crops, near Mareeba in Far Northern Queensland. The increasing popularity of Lake Tinaroo as a recreation and tourist venue is providing impetus for a management plan to be prepared for the lake. Urban and agricultural use of the catchment has caused a change in the trophic state of the lake. The competing and emerging issues in relation to a sustainable, healthy lake are discussed. The Queensland Water Resources Commission sees its role, as lead agency, to bring about a new management plan for the lake and its catchment. Steps are being taken to move in this direction through coordinating expert advice and involving the local community. The Commission has established an Advisory Committee to: assess the trophic status of the lake; identify the nutrient load and the limiting nutrient on the lake and in the receiving waters; project the nutrient loading trend; project the trophic status trend; and outline alternative intervention strategies and recommend action. (Sand-PTT)
W89-12216

EFFECTS OF SALINE FLUSHING TO A POLLUTED ESTUARY TO ENHANCE WATER QUALITY STANDARDS.
Deakin Univ., Melbourne (Australia). Div. of Biological and Sciences.
P. M. Nuttall, B. J. Richardson, and P. Condina.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 167-176, 1989. 6 fig, 3 tab, 17 ref.

Descriptors: *Estuaries, *Eutrophication, *Water pollution treatment, *Rehabilitation, *Saline water, *Water quality, *Flushing, Macroinvertebrates, Phytoplankton, Cyanophyta, Fish, Dissolved oxygen, Submerged plants, Sand, Silt, Color, Odors, Recreation, Kananook Creek, Australia, Sediments.

Kananook Creek, a polluted estuary in urban Victoria, Australia, was monitored for water quality data over a 7-year period. Prior to saline flushing, low species diversity dominated by high numbers of organic pollution-tolerant macroinvertebrates, phytoplankton blooms and cyanobacterial mats occurred throughout the estuary in clearly defined zones. Low dissolved oxygen levels restricted fish movement. Sand and silt deposition in the estuary prevented submergent aquatic plant colonization, primarily as a result of the unstable, shifting nature of the substratum. Subsequent saline flushing at a maximum continuous rate of 150 megaliters/day saltwater from a coastal waterway improved quality within the water column of the polluted estuary. Although flushing reduced the incidence of freshwater species, estuarine fauna and flora rapidly colonized much of Kananook Creek. The incidence of phytoplankton blooms, water discoloration and odor was reduced to the benefit of recreation demands placed upon the creek. Polluted and unstable sediments continued to restrict macroinvertebrate establishment and occasional cessation in flushing for pump maintenance caused a rapid deterioration in water quality. (Author's abstract)
W89-12225

WATER QUALITY MANAGEMENT AT PALM MEADOWS GOLF COURSE (AUSTRALIA) BY LIMITED TIDAL EXCHANGE.
Winders, Barlow and Morrison Pty Ltd., Brisbane (Australia).
C. J. Milligan, and A. B. McAlister.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 211-216, 1989. 3 fig, 1 tab.

Descriptors: *Artificial lakes, *Tidal hydraulics, *Recreation, *Water quality management, *Mathematical models, *Simulation, Golf course, Model studies, Cost analysis, Maintenance costs.

A tidal exchange system for lakes within a golf course on the Queensland Gold Coast was designed and constructed to maintain aesthetic appeal while retaining approximately constant water levels. Secondary objectives of minimal maintenance, yet ability of the system to support water-based recreation, were also defined. To achieve this, a simulation of potential lake layouts and their tidal hydraulics was achieved using ESTRY, a hydrodynamic modelling program. Output from the model defined the necessary design criteria. This allowed significant cost savings in civil works to be achieved during construction and minimal ongoing maintenance costs in the developed golf course complex. Confirmation of fulfillment of the design criteria has been provided by the satisfactory agreement between predicted model results and actual characteristics of the lakes and the results of a water quality monitoring program. (Author's abstract)
W89-12232

REVIEW OF WATER QUALITY AND MANAGEMENT PROBLEMS IN CANAL ESTATES IN WESTERN AUSTRALIA.
Waterworks Commission, Perth (Australia).
For primary bibliographic entry see Field 5C.
W89-12233

BIOLOGICAL ASPECTS OF WATER MANAGEMENT.
Capricornia Inst. of Advanced Education, Rockhampton (Australia). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W89-12236

WIMMERA RIVER (VICTORIA, AUSTRALIA: INCREASING USE OF A DIMINISHING RESOURCE).
Horsham City Engineer's Dept. (Australia).
L. Campbell.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 245-249, 1989. 1 fig.

Descriptors: *River basin development, *Water quality management, *Water resources development, *Water management, *Recreation, *Australia, Water quality, Wimmera River, Weed control, Lakes.

The Wimmera River is central Victoria's most important river, rising in the Grampians National Park, filling storages that supply the major water supply to the vast Wimmera and Mallee regions. It passes through the Little Desert National Park, an area of significant scenic, recreation, historical and conservation value and terminates in Victoria's largest inland freshwater lakes (lakes Hindmarsh and Albacutya). The brittleness of the whole closed Wimmera River system, and the over-committal of the water resources was brought to the public's attention when appeals were lodged against the proposal to license a discharge of high standard secondary effluent from an extended aeration oxidation ditch and lagoon treatment facility at Horsham. Residents, user and community groups, municipal councils and government departments, aware of the deterioration of the Wimmera River, had somewhere to focus their attention. Victoria's and possibly Australia's longest environmental appeal, lasting 25 days, and a state environment protection policy, determined that all major point sources of nutrients should be removed from the river. More resources for clearing of unwanted emergent weeds, more facilities for protection of Crown Land and catchments generally, and the implementation of environmental summer flows as piping of the Wimmera-Mallee Stock and Domestic Systems proceeds, are all required. A River Management Board with strength, wealth, good public relations and a dedication to the task could make the Wimmera River an example for all Australia and a tourist attraction of immense value to the region. (Author's abstract)
W89-12237

FROM CANALS TO LAKES IN SOUTHEAST QUEENSLAND (AUSTRALIA): WATER QUALITY ASPECTS.
T. C. Johnson, and S. H. Williams.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 261-265, 1989. 3 fig.

Descriptors: *Artificial lakes, *Canals, *Waterways, *Lakes, *Water quality, *Australia, Design criteria, Dissolved oxygen, Urban planning, Saline lakes.

The majority of waterway based residential developments in southeast Queensland are based on the tidally restricted lake concept. While these lakes have so far behaved satisfactorily from a water quality aspect, at this stage the age of these lakes is insufficient to decide whether there are likely to be any longer term problems. It would appear that provided a reasonable amount of salinity is maintained, and nutrient inflows are controlled to some extent, no significant detrimental effects are likely to occur. In order to assure adequate water quality, an approach has been adopted of adhering to a list of desirable design parameters. The first requirement is that the lake be no more than 4 m deep. This will normally assure that adequate mixing will occur to maintain good dissolved oxygen contents over the depth of the lake. The second requirement is that the designer should aim for a through flow water exchange system, whether the exchange is achieved by tidal forcing or by mechanical pumping. In situations where the increase in tidal compartment is not restricted, a single entrance scheme can be used. A number of developments which meet these criteria are presently being planned. The deep lake, in excess of 5 m, should only be adopted as a last resort. The satisfactory operation of existing saline lakes of this type has more to do with the climatic conditions prevailing in southeast Queensland than with any satisfactory consideration of possible problems. More research and testing is required before an adequate data base of knowledge is available to assist the designers of such structures. (Sand-PTT)
W89-12240

WATER QUALITY AND MANAGEMENT IN THE GREAT BARRIER REEF MARINE PARK.
Great Barrier Reef Marine Park Authority, Townsville (Australia).
For primary bibliographic entry see Field 5B.
W89-12241

WATER QUALITY MANAGEMENT: A TOTAL CATCHMENT MANAGEMENT APPROACH.
Parramatta Dept. of Water Resources (Australia). Water Resources Management Div.
W. J. Hawkins, and D. A. Geering.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 281-288, 1989. 5 tab, 2 ref.

Descriptors: *Water quality management, *Watershed management, *Resources management, *Australia, Nymboida River, Murrumbidgee River, Hawkesbury/Nepean River.

Water quality standards set in the past have not helped resource managers in the decisions that they face in seeking sustainable development. Resource managers are looking for meaningful information on water quality so as to evaluate the resource, set priorities for action, and to monitor progress. Resource managers need to know how water quality affects, and is affected by, catchment use and activities. Examples of three wild and scenic rivers, the Nymboida, Murrumbidgee, and Hawkesbury/Nepean River systems, demonstrate how a 'Total Catchment Management' approach to resource use and resource protection has advantages for water quality management. (Author's abstract)
W89-12243

WATER, HEALTH, RECREATION AND TOURISM.
Department of Community Services, Woden (Australia). Environmental Health Section.
A. Wade.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 297-302, 1989. 7 tab, 14 ref.

Descriptors: *Recreation, *Tourism, *Water quality control, *Public health, *Water pollution prevention, Estuaries, Lakes, Rivers, Nonpoint pollution sources, Land use, Licenses.

Tourists and holiday makers have a closer than 'normal living' association with the water cycle. Tourists are particularly sensitive to the effects of changing water quality. The health effects of water-based recreational pursuits were examined for closed or controlled recreational waters such as swimming pools, spas, slides and hydrotherapy pools, and open recreational waters such as beaches, estuaries, lakes and streams. For the controlled recreational waters, two basic requirements are good housekeeping and good chemical dosing practice. This requires keeping the water free of debris, providing supervision for children, maintaining equipment and filter pumps, maintaining the proper water pH and levels of disinfectants. Open recreational waters are not usually amenable to direct treatment to improve water quality. The strategy needed is to place direct controls on polluters. For point-source pollution, discharges to waterways and groundwater can be controlled by stringent licensing requirements. For non-point source pollution such as agricultural runoff, pollution control is expensive and difficult to achieve. However, environmental damage resulting from uncontrolled land use practices is being slowly recognized as being so massive as to justify more controls. The tourist industry has self-interest in paying close attention to water quality problems and must invest in the best water treatment technology. It should also lobby for the protection of natural waterways and waterbodies and indicate to local and State or Territory governments the costs of not requiring effective pollution control measures. (Sand-PTT)
W89-12245

ECOLOGICAL PROBLEMS IN CONNECTION WITH SMALL RIVERS (EKOLOGICHESKIE PROBLEMY EKSPLUATATSII MALYKH REK).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 4A.
W89-12265

MACROBENTHOS IN THE COASTAL ZONE OF THE BLACK SEA AFTER CESSATION OF WASTE DISCHARGE (MAKROBENTOS PRIBREZHNOI ZONY CHERNOGO MORYA POSLE PREKRASHCHENIYA SBROSA STOCHNYKH VOD).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
M. I. Kiseleva.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 23, No. 1, p 40-43, 1987. 1 fig, 1 tab, 5 ref. English summary.

Descriptors: *Water pollution prevention, *Water quality, *Black Sea, *Benthos, *Wastewater disposal, Species composition, Population density, Biomass, Coastal waters.

Benthos development in the Black Sea coastal region of Yalta was compared for 1969 (the period of wastewater discharge) and 1982 (six yr after discharge ceased). Species composition has not changed significantly. The species community coefficients were high (up to 50). Density of the benthos population was 1.5-3 times higher and biomass 13-28 times higher in 1989 than in 1969. The Venis gallina community typical of pure waters has formed in the coastal zone at depths of 10-20 m. Judging from the composition and quantitative development of the benthos the degree of pollution in the region has decreased. (Author's abstract)
W89-12268

NEED FOR THE INTRODUCTION OF A NEW CATEGORY OF 'NATURE RESERVE' IN THE UKRAINE REPUBLIC TERRITORY (O NEOBKHODIMOSTI VVEDNIIA NOVOI KATEGORII ZAPOVEDNOSTI NA TERRITORII UKRAINSKOI SSR).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 4C.
W89-12270

BIOTREATMENT OF DILUTE CONTAMINATED GROUND WATER USING AN IMMOBILIZED MICROBE PACKED BED REACTOR.
Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
R. J. Portier, J. A. Nelson, J. C. Christianson, J. M. Wilkerson, and R. C. Bost.
Environmental Progress, Vol. 8, No. 2, p 120-125, May 1989. 4 fig, 8 ref.

Descriptors: *Decontamination, *Cleanup operations, *Microbial degradation, *Groundwater pollution, *Biological treatment, *Pesticides, *Packed bed reactor, Activated carbon, Organic compounds, Water treatment, Plug flow.

A biological treatment process employing immobilized microbial populations was field tested on contaminated ground water having dilute concentrations of volatile organics and organic pesticides. The process, consisting of two packed bed reactors in series containing specific adapted microbial strains immobilized on a porous diatomaceous earth support, was operated in a plug flow configuration over a 90-day period at a flow rate of 80 gallons per day. Process viability of this multiple microbe/multiple toxicant treatment approach was determined based upon comparisons to carbon adsorption technology. (Author's abstract)
W89-12300

PHYSICAL AND CHEMICAL BEHAVIOR OF STABILIZED SEWAGE SLUDGE BLOCKS IN SEAWATER.
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
For primary bibliographic entry see Field 5E.
W89-12384

COMPLEX OPERATION OF TARP MAINSTREAM SYSTEM SIMPLIFIED BY COMPUTER CONTROLS.
Metropolitan Sanitary District of Greater Chicago, IL.
For primary bibliographic entry see Field 5D.
W89-12397

COMPUTERIZING THE PLANNING, ANALYSIS AND MAINTENANCE OF WATER SYSTEMS.
Psomas and Associates, Santa Monica, CA.
For primary bibliographic entry see Field 6A.
W89-12398

ECONOMIC EFFECTS OF SALINITY AND DRAINAGE PROBLEMS.
Rhode Island Univ., Kingston. Dept. of Resource Economics.
For primary bibliographic entry see Field 3C.
W89-12420

DESALINIZATION OF AN IRRIGATED, MOLE-DRAINED, SALINE CLAY LOAM SOIL.
Agriculture Canada, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 2G.
W89-12429

STUDIES ON ACTIVITY RECOVERY IN SOME MERCURY-EXPOSED FRESHWATER FISH BY USING SELECTED WEEDS.
Vikram Univ., Ujjain (India). School of Studies in Zoology.
S. Shrivastava, and K. S. Rao.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 6, p 840-846, June 1989. 3 fig, 1 tab, 12 ref.

Descriptors: *Fish behavior, *Water quality control, *Mercury, *Aquatic weeds, *Decontamination, *Fish, *Toxicity, Aquatic plants, Floating plants, Submerged plants, Fish physiology, Heavy metals, India, Water pollution, Population exposure, Water hyacinth.

The present study evaluated the relative efficiencies of five selected weeds in mercury toxicity removal, suggesting possible methods of mercury removal from contaminated aquatic environments. Sarotherodon mossambicus, Heteropneustes fossilis, and Puntius sophore were selected as test animals. The selected weeds were Eichhornia, Salvinia, Hydrilla, Vallisneria, and Marsilea, which basically represent floating, emergent, and submerged types. The weeds were allowed to remain in the experimental water with the toxicant for a period of 48 hours. The fish were then introduced. Twenty to 30% mortality was recorded in all fish in the lethal concentration containing Eichhornia, 40 to 90% mortality was recorded with Salvinia, and 70 to 100% mortality with Vallisneria, Hydrilla, and Marsilea. Eichhornia was established in this group as the weed having the highest capacity of mercury removal from the medium. Next in order were Salvinia, Hydrilla, and Vallisneria. Oxygen consumption rate, opercular movements, and locomotory activity of fish were observed in different experimental groups. These observations also support that the weed containing group were comparatively under less toxicity stress of mercuric chloride. (Doria-PTT)
W89-12445

CONSTRUCTION OF A WATERTIGHT DIAPHRAGM BY THE BARRETTE METHOD WITH THE USE OF A BARRAGE MACHINE.
L. A. Golub.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 7, p 388-389, January 1989. 2 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 7, p 17-18, July 1988.

Descriptors: *Industrial wastes, *Rapid excavation, *Groundwater pollution, *Groundwater barriers, *Water pollution control, Construction equipment, Sludge lagoons, Linings, Industrial plants, Groundwater management, Agricultural chemicals, Trenches, Excavation, USSR.

Groundwater protection is part of the project of reconstruction and expansion of a fertilizer plant in the USSR. A detailed study of the project materials and situation at the plant showed that the watertight facings of the sludge ponds have become unfit for use, and a territory with an area of 1500 hectares adjacent to the industrial enterprise and subsurface waters are severely polluted by wastewaters seeping from the ponds. Methods of protecting the river from the entry of water from the plant territory were examined, along with possible groundwater treatment programs. The most acceptable solution was the construction of a watertight diaphragm, with a length of 4.5 km and a depth of 12-15 m, by the barrette method in sand-clay soils with an inclusion of gravel, along the river. The barrage machine chosen for digging the trench and constructing the curtain is highly productive, performs high-quality trimming of the walls and bottom of the trench, and eliminates the need for additional equipment for digging a pilot hole. The time of the work is shortened still more due to the fact that the set of equipment makes it possible to prepare the clay slurry directly in the trench zone using mainly the clays being excavated from the trench. As a result of using this particular barrage machine in the construction of a watertight diaphragm, an annual reduction of capital expenditures, labor expenditures, and project time is achieved. (Fish-PTT)
W89-12462

ADMISSIBILITY OF DEVIATING FROM THE THOMA CRITERION WHEN DESIGNATING THE CROSS-SECTIONAL AREA OF SURGE TANKS.
For primary bibliographic entry see Field 8C.
W89-12465

MATHEMATICAL MODEL OF PHOSPHATE RELEASE RATE FROM SEDIMENTS CONSIDERING THE EFFECT OF DISSOLVED OXYGEN IN OVERLYING WATER.
Tokyo Univ. of Fisheries (Japan). Dept. of Food Science and Technology.
M. Ishikawa, and H. Nishimura.
Water Research WATRAG, Vol. 23, No. 3, p 351-

359, March 1989. 4 fig, 5 tab, 56 ref.

Descriptors: *Cycling nutrients, *Limiting nutrients, *Algae, *Lakes, *Water quality management, *Phosphates, *Dissolved oxygen, *Oxygen requirements, *Mathematical models, Oxygenation, Iron oxides, Surface water, Diffusion coefficient, Lake sediments, Japan, Prediction.

Phosphate is frequently the limiting nutrient for the growth of algae in lakes, hence the prediction of phosphorus input into lakes is necessary for water-quality management. A quantitative model of phosphate release rate from sediment considering the effect of dissolved oxygen (DO) in overlying water was developed and compared with the experimental data. The model considered the diffusion, adsorption, and desorption of phosphate; the diffusion, oxygenation, and hydroxide formation of ferrous iron; and the bacterial oxygen consumption. The phosphate release flux was obtained as a linear decreasing function of DO in the overlying water. The critical concentration of DO in the overlying water at which the phosphate release is stopped was expressed as a function of the thickness of the oxygenation layer which depends on the ferrous iron diffusion coefficient. The prediction by the present model when the bacterial oxygen consumption rate was small, was favorably compared with the observed data in Lake Teganuma. (Author's abstract)
W89-12489

LAKE AND RESERVOIR MANAGEMENT.
Environmental Protection Agency, Dallas, TX. Region VI.
For primary bibliographic entry see Field 2H.
W89-12535

SUBSTRATE ASSOCIATED MICROFAUNA.
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 2H.
W89-12543

EXPERIENCES WITH REDUCING POINT SOURCES OF PHOSPHORUS TO LAKES.
Canberra Coll. of Advanced Education, Belconnen (Australia). Water Research Centre.
P. Cullen, and C. Forsberg.
Hydrobiologia HYDRB8, Vol. 170, p 321-336, December 1988. 1 tab, 72 ref.

Descriptors: *Water pollution control, *Phosphorus, *Eutrophication, *Pollution load, Lakes, Cycling nutrients, Performance evaluation, Limnology, Prediction, Management planning, Decision making.

Experiences over the last 25 yr have demonstrated that eutrophication can be reversed, and that phosphorus is most often the nutrient through which control should be exerted. The reduction of the external load of phosphorus to a eutrophic lake is a necessary condition for lake restoration, but may not in itself be sufficient. Three main response patterns to a reduction in external load are identified. These include reduction in lake phosphorus that leads to sufficient reduction in chlorophyll to change the trophic category, to make the lakes 'less eutrophic' or have small or no effect. The factors that determine the actual response are discussed. It is clear that interventions to restore eutrophic lakes have not always given the results expected. Limnological studies are necessary for well-grounded predictions. Several tools are employed in decision making prior to intervention; these include: N:P ratio, algal growth potential tests, phosphorus budget, comparative studies, hydrologic models, sediment release data, and published comparative information. (Author's abstract)
W89-12591

TIME SERIES ANALYSIS OF WATER QUALITY DATA IN PEARL RIVER, CHINA.
Hong Kong Univ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W89-12618

EFFECTS OF ORGANIC ENRICHMENT ON MEIOFAUNA: A LABORATORY STUDY.
Naples Univ. (Italy). Dipt. Genetica, Biologia Generale e Molecolare.
R. Sandulli, and M. De Nicola Giudici.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 5, p 223-227, May 1989. 6 fig, 3 tab, 15 ref.

Descriptors: *Water pollution effects, *Enrichment, *Dissolved solids, *Bioindicators, *Benthic fauna, *Eutrophication, Copepods, Biomass, Aquatic animals, Cycling nutrients, Ecosystems, Nematodes, Sludge.

An experiment was conducted to examine the effects of different loadings of organic enrichment on meiobenthos and, in particular, on its most abundant components, nematodes and harpacticoid copepods, to assess their potential as environmental quality indicators. An 84 day laboratory experiment indicates the decline of intertidal meiofauna abundance may be directly related to treatment level and time of exposure to sewage sludges. The observed changes revealed a marked decrease of nematodes and total disappearance of mesobenthic harpacticoids while the non-interstitial copepod species were little affected. Results support the use of the nematode/copepod ratio as an index of organic pollution, and its used could be enhanced by considering in the calculation only truly interstitial species, apparently the most sensitive to environmental stress, since differences in the habitat requirements of nematodes and copepods may be essential to determine their response to organic enrichment. (Friedmann-PTT)
W89-12646

MAPPING THE ECOLOGICAL IMPACT OF HEAVY METALS ON THE ESTUARINE POLYCHAETE NEREIS DIVERSICOLOR USING INHERITED METAL TOLERANCE.
Hull Univ. (England). Dept. of Applied Biology.
A. Grant, J. G. Hateley, and N. V. Jones.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 5, p 235-238, May 1989. 2 fig, 2 tab, 16 ref.

Descriptors: *Physiological ecology, *Ecological effects, *Polychaetes, *Water pollution effects, *Bioindicators, *Heavy metals, *Estuaries, Tolerance, Macroinvertebrates, Zinc, Trace elements, Ecosystems, Aquatic animals, England, Copper.

The presence at a particular location of a population of a species that has shown elevated tolerance to a contaminant is evidence of an ecological impact by that substance or a close chemical relative. Tolerance to copper and zinc in the polychaete Nereis diversicolor is inherited. The occurrence of metal tolerant individuals of this species was used to map the ecological impact of contamination by these metals. It was found that in the chronically contaminated Restronguet Creek, Cornwall, England, the effect of zinc is restricted to an area within 1 km of the head of the estuary and becomes negligible by the estuary mouth. Sediment levels of more than 1000 micrograms/g copper and 3500 micrograms/g zinc can be of no ecological significance for this species. The degree of metal tolerance reduces rapidly as the level of contamination decreases, suggesting that metal tolerant individuals are competitively inferior to normal individuals in clean environments. (Friedmann-PTT)
W89-12649

VOLATILIZATION OF SELENIUM BY ALTERNARIA ALTERNATA.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W89-12652

HYBRIDIZATION OF DNA PROBES WITH WHOLE-COMMUNITY GENOME FOR DETECTION OF GENES THAT ENCODE MICROBIAL RESPONSES TO POLLUTANTS: MER GENES AND HG(2+) RESISTANCE.
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W89-12659

OBSERVATIONS ON BLUE-GREEN ALGAL BLOOMS IN THE OPEN WATERS OF LAKE VICTORIA, KENYA.
Kenya Marine and Fisheries Research Inst., Kisumu. Kisumu Lab.
For primary bibliographic entry see Field 2H.
W89-12664

LONG-TERM DESTRATIFICATION IN AN ILLINOIS LAKE.
Illinois State Water Survey, Peoria. Water Quality Section.
R. K. Raman, and B. R. Arbuckle.
Journal of the American Water Works Association JAWWA5, Vol. 81, No. 6, p 66-71, June 1989. 5 fig, 7 tab, 4 ref.

Descriptors: *Limnology, *Water quality control, *Lake restoration, *Illinois, *Destratification, *Organoleptic properties, *Water supply, *Water supply, *Reservoirs, Water treatment, Water treatment facilities, Drinking water, Municipal water, Economic aspects, Taste, Odors, Cyanophyta, Oxygenation, Iron, Manganese, Chlorine, Cost analysis, Operating costs, Maintenance.

Lake Eureka was created in 1942 to serve as a water supply source for Eureka, Ill., but because of persistent complaints about tastes and odors, in 1979 the city abandoned the lake and switched to groundwater. A low-energy mechanical destratifier installed in the deepest part of the lake and chelated copper sulfate application to control blue-green algae were first used in 1981 to improve water quality. The aerator has destratified the lake and maintained adequate oxygen levels. Iron and manganese concentrations in deep water have been reduced by 95 to 97 percent from the predestratification levels. Chlorine demand values have been reduced by more than half, and the problem-causing blue-green algae have been brought under control. The city reinstated the lake as its water supply source in April 1982 and has realized a 50 to 60 percent saving in annual plant operating costs over the past six years. The switch in supply source resulted in a significant savings in power and chemical consumption, particularly lime and carbon dioxide. The change in raw water supply also alleviated several operational problems. The volume of softening sludge decreased significantly, resulting in less sludge storage and fewer handling requirements. Excessive floc carry-over to filter beds, clogging of sludge discharge conduits, and a host of other related plant maintenance and operational problems were brought under control. (Author's abstract)
W89-12695

EVALUATION OF PRODUCTION AND DEEUTROPHICATION MEANS AMONG CYSTOSEIRA POPULATIONS IN A SEA EUTROPHICATION ECOSYSTEM (OTSENKA PRODUKTSIONNYKH I DEEVTROFIKATSIONNYKH VOZMOZHNOSTEI POPULIATSII TSISTOZIRY V MORSKOI EVTROFIRMEMOI EKOSISTEME).
Akademiya Nauk URSR, Sevastopol. Inst. Biologii Yuzhnykh Morei.
S. E. Zavalko.
Gidrobiologicheski Zhurnal GBZUAM, Vol. 25, No. 1, p 16-21, 1989. 6 fig, 1 tab, 10 ref. English summary.

Descriptors: *Black Sea, *Eutrophication, *Water pollution control, *Algae, *Marine algae, Nitrogen removal, Coastal waters, Aquatic plants, Cytoseira, Aquatic productivity.

Eutrophy and water mobility were studied for their joint effect on the production of Cytoseira, a natural brown algae population found in the Black Sea. Using the data obtained, the possibility of removing nitrogen from the eutrophied ecosystem as Cytoseira phytomass was estimated. A decrease in the production of Cytoseira populations in the eutrophied ecosystem and the elimination of the greater portion (90%) of the produced phytomass

indicated that Cystoseira had a low efficiency as a means of reversing eutrophication. Cystoseira production may be three times as high and may attain the level of non-eutrophied ecosystems under a corresponding increase of water mobility. However, water mobility in the coastal zone is often not intensive enough to stimulate the production of Cystoseira population, thus causing the macrophyte depression in the eutrophied ecosystem. The role of Cystoseira as a supplier of phytomass in the marine environment in complexes with phyto-and detritophages is of greater value than its role in reversing eutrophication. (Author's abstract)
W89-12717

GLIMMER OF HOPE FOR STREAM FISHERIES IN MISSISSIPPI.
Mississippi State Univ., Mississippi State. Dept. of Wildlife and Fisheries.
For primary bibliographic entry see Field 8I.
W89-12746

GROUNDWATER CONTAMINATION: PUMP-AND-TREAT REMEDIATION.
California Univ., Los Angeles. School of Public Health.
D. M. Mackay, and J. A. Cherry.
Environmental Science and Technology ESTHAG, Vol. 23, No. 6, p 630-636, June 1989. 3 fig, 1 tab, 29 ref.

Descriptors: *Groundwater pollution, *Water pollution treatment, *Cleanup, *Site remediation, Pump wells, Pump-and-treat, Contamination.

Reasons are explored for the typically slow cleanup of groundwater contamination by organic chemicals using the common pump-and-treat approach. At many sites of significance, a relatively large mass of contaminants has been leaked, spilled, or disposed into the subsurface, and in comparison the rate of contaminant mass removal by pumping wells is exceedingly slow. In such cases, the pump-and-treat option is best thought of as a management tool to prevent, by hydraulic manipulation of the aquifer, continuation of contaminant migration. This option often effectively shrinks the plume toward its sources, but for the shrinkage to persist, it is necessary to continue pumping. Even if contaminants remain in some portions of the aquifer, it is often possible to eliminate real, potential, or perceived risks by such hydraulic influence. However, the long-term cost of such pumping with treatment of the extracted water is often high whether measured in dollars spent for system operation and maintenance or in gallons of previously uncontaminated groundwater used to flush out the contaminants. At quite a few sites, the dissolved mass of organic contaminants in relatively large plumes is quite small, less than that present in one drum of pure chemical. This suggests that seemingly innocuous and often unnoticed leakages or spills of a few gallons per day or less, so common at many industrial and military sites, may pose a major threat to groundwater. (Miller-PTT)
W89-12756

ECONOMIC ANALYSIS OF WATER HYACINTH PRODUCTION AND CONVERSION TO METHANE: THE POTENTIAL FOR LAKE RESTORATION.
Florida Univ., Gainesville. Dept. of Food and Resource Economics.
For primary bibliographic entry see Field 2H.
W89-12762

ACID RAIN GAMES: INCENTIVES TO EXAGGERATE CONTROL COSTS AND ECONOMIC DISRUPTION.
Wyoming Univ., Laramie. Dept. of Economics.
For primary bibliographic entry see Field 6B.
W89-12763

PRACTICAL CONSIDERATIONS IN THE SURFACTANT-AIDED MOBILIZATION OF CONTAMINANTS IN AQUIFERS.
Ohio State Univ., Columbus. Dept. of Civil Engineering.
B. W. Vigon, and A. J. Rubin.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 7, p 1233-1240, July 1989. 6 fig, 4 tab, 17 ref. EPA Research Project No. R811732-01-0.

Descriptors: *Water pollution treatment, *Oil pollution, *Surfactants, *Aquifers, *Groundwater pollution, *Cleanup operations, Surface tension, Soil organic matter, Desorption, Adsorption, Organic compounds.

A series of nonionic surfactants were tested with two model contaminants, anthracene and biphenyl in an artificial soil for their ability to remove the contaminants from an artificial groundwater. Surfactants evaluated included three alkylphenolethoxylates and two alkyl ethoxylates. Performance parameters examined included surface tension minimization, critical micelle concentration (CMC), hydrophile-lipophile balance (HLB) number, solubilization efficiency, and partition coefficient. Each performance parameter was found to be useful, but by itself inadequate. The principal limitations were their insensitivity to surfactant structure, unknown applicability to solid phases and lack of specificity to individual contaminants. Dodecylphenolethoxylates with 5 ethoxylate units were more extensively adsorbed than the other two surfactants. The order of adsorption for this series of surfactants is the reverse of the HLB order. Efficiency of removal for all surfactants was less than 10% at doses of 0.1% weight and below. Adsorption onto the soil at low doses did not contribute to decontamination performance. All surfactants favorably reduced the partition coefficients of the respective contaminants at doses above 0.1% weight. The optimal dose, considering both technical and economic factors, is that at which the marginal cost of surfactant (including post-treatment) equals the marginal savings in restoration time. (Geiger-PTT)
W89-12848

HYDROLOGIC ALTERATION OF MOUNTAIN WATERSHEDS FROM SURFACE MINING.
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
P. S. Dickens, R. A. Minear, and B. A. Tschantz.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 7, p 1249-1260, July 1989. 3 fig, 7 tab, 32 ref.

Descriptors: *Mine wastes, *Groundwater pollution, *Acidic water, Environmental effects, Tennessee, Leachates, Coal mining, Weathering, Water quality, Land reclamation.

Surface mining impacts on the hydrologic environment of the New River Basin (Tennessee) were studied for 14 yr between 1972 and 1985. State and federal regulations resulted in changes in mining and reclamation technology that improved stream water quality in the studied watersheds. The water quality improvements is caused by the segregation of acid-forming spoil materials and the elimination of coal seam augering. The steep-slope contour surface mining spoil is a large reservoir of water and dissolved mineral constituents. The removal of forest cover by mining and the storage and interception of water by the mining spoil alter the hydrologic environment of mountain watersheds. The rate of weathering of geologic materials is greatly increased while evapotranspiration is reduced. Streamflow volume and constituent mass output from watersheds disturbed by mining are substantially increased. The result is a long-term change in water quality. (Author's abstract)
W89-12850

REMEDIAL INVESTIGATION OF AN ORGANICALLY POLLUTED OUTWASH AQUIFER.
National Water Research Inst., Burlington (Ontario).
R. E. Jackson, and R. J. Patterson.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 3, p 119-125, 1989. 9 fig, 2 tab, 17 ref.

Descriptors: *Glacial aquifers, *Water pollution treatment, *Groundwater pollution, *Organic solvents, *Landfills, *Cleanup operations, *Water pollution control, Groundwater barriers, Permeability, Pump wells, Wastewater facilities, Artificial recharge, Biodegradation, Remedies, Canada, Field tests, Bioremediation.

A glacial outwash aquifer underlying the Gloucester Landfill near Ottawa, Canada, has become polluted with various organic chemicals following the disposal of laboratory solvents in shallow trenches immediately above the aquifer. Several remedial alternatives have been considered by the government of Canada. Impermeable barrier walls were rejected as being unsuitable given the permeable nature of the underlying bedrock. It appears improbable that pools of liquid organic chemicals exist within the aquifer, although ganglia are likely present. Therefore, much of the contaminant plume can be removed hydraulically over a period of five years by the operation of four purge wells discharging to an on-site treatment plant from which the purified water is returned to the aquifer by recharge wells. The residual contamination is anticipated to be cleaned up by in situ biorestoration techniques currently under development. (Author's abstract)
W89-12875

WATER QUALITY MANAGEMENT IN THE RUHR AREA.
Ruhrverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W89-12911

ASSESSMENT AND MANAGEMENT OF SURFACE WATER QUALITY IN ENGLAND AND WALES.
Water Research Centre, Medmenham (England).
D. G. Miller, and J. A. Tetlow.
Regulated Rivers Research and Management RRRMEP, Vol. 4, No. 2, p 129-137, July 8, 1989. 3 fig, 1 tab, 14 ref.

Descriptors: *Water quality management, *Water pollution control, *Surface water, *Water quality standards, Public investments, Environmental policy, Economic aspects, Water resources development, Monitoring, England, Wales, United Kingdom.

In the U.K., the management of surface water quality is becoming more influenced by the European Commission. Pollution Control Authorities are required increasingly to assess and report to the public and their elected representatives on the quality of environmental waters and effluents. The public want to see whether water quality is improving and whether it is getting value-for-money. It is vital that the data collected on water quality and water quality standards are used properly to assess performance so that the resources needed for pollution control are neither exaggerated, underestimated, or applied to the wrong areas. This demands that the following tasks form a rigorously integrated package: the definition and setting of standards; the monitoring of water quality; performance assessment; and planning. One certainty is that pressure for an improved environment will continue to be voiced by Parliament, pressure groups, the media, and the public. This pressure will be sharpened in the era of a private water industry. It is hoped that all these aims will be achievable, and, if not, that resources can be spent on the problems which are genuinely most serious. (Author's abstract)
W89-12912

AQUATIC INVERTEBRATE SURVEYS AS A WATER QUALITY MANAGEMENT TOOL IN THE ANGLIAN WATER REGION.
Anglian Water Authority, Lincoln (England). Lincoln Div.
For primary bibliographic entry see Field 5A.
W89-12913

RIVER WILDLIFE DATABASES AND THEIR VALUE FOR SENSITIVE ENVIRONMENTAL MANAGEMENT.

Anglian Water Authority, Lincoln (England). Lincoln Div.
For primary bibliographic entry see Field 2H.
W89-12917

ASSESSMENT OF THE VALUE OF RIVERS FOR OTTERS.
Vincent Wildlife Trust, London (England).
For primary bibliographic entry see Field 2H.
W89-12919

CONSERVATION VALUE OF WATER SUPPLY RESERVOIRS.
Anglian Water Authority, Oundle (England). Oundle Div.
For primary bibliographic entry see Field 2H.
W89-12920

WELSH RIVERS AND RESERVOIRS: MANAGEMENT FOR WILDLIFE CONSERVATION.
University Coll., Cardiff (Wales). School of Pure and Applied Biology.
R. Edwards, and R. Howell.
Regulated Rivers Research and Management RRRMEP, Vol. 4, No. 2, p 213-223, 8 July 1989. 7 fig, 1 tab, 28 ref.

Descriptors: *Wildlife conservation, *Water management, *Environmental impact statement, *Environmental policy, *Ecosystems, Water quality control, Resources management, Interagency cooperation, Acid rain, Land use, Pollution control, Wastewater treatment, Flood control, River systems, Reservoirs, Predation, Engineering, Recreation demand, Wales.

Conservation of wildlife in all ecosystems depends on the maintenance of the physical and chemical habitat within prescribed limits. In the U.K. several important factors are not readily controlled by regional regulatory agencies, but require Governmental control and action; these include acid-rain and land-use policy. Where local water authorities have control--to provide wholesome water, treat and dispose of sewage, control pollution, protect properties from flooding, conserve wildlife--there are times when compromises must be made. The factors examined are those affecting wildlife conservation in rivers and reservoirs in Wales over which some regulation is possible: predators, engineering works, point-source pollution, river flow, and human disturbance. Current procedures for biological assessment are discussed to describe pollution from chronic sources in terms of simple indices and scores. It is hoped that new surveillance techniques will provide an increasing awareness of the importance of the banks of rivers as linear habitats, and will address the problem of our ignorance of the fauna and flora of many lakes and reservoirs. Sensitive management of recreational sites may reduce disturbance in many instances, but environmental damage through habitat modification needs further evaluation and recognition in environmental protection policies. Factors outside the control of regional regulatory agencies impinge directly on their ability to conserve aquatic ecosystems. (Fish-PTT)
W89-12921

SIMULATION OF BUBBLE PLUME DESTRATIFICATION SYSTEMS IN RESERVOIRS.
Western Australia Univ., Nedlands. Centre for Water Research.
J. C. Patterson, and J. Imberger.
Aquatic Sciences, Vol. 51, No. 1, p 3-18, 1989. 9 fig, 19 ref.

Descriptors: *Water quality control, *Lakes, *Aeration, *Destratification, *Lake restoration, Stratification, Mixing, Reservoirs, Model studies, DYRESM model, Myponga Reservoir, Australia, Bubble plumes.

A model of the dynamics of a bubble plume was incorporated in the one-dimensional model of reservoir dynamics DYRESM and tested against a data set from Myponga Reservoir in South Australia. The model provided a reasonably good simulation of the dynamics and allowed use of the combined model for determining the behavior of aerators under a number of operational strategies. It showed that the peak efficiency in excess of 15% could be achieved from a single bubble plume, and that the total efficiency of an aerator operating with a fixed airflow rate and fixed configuration over a full season was increased from 1.5% to about 5.5% by a simple control method. The model indicated that total efficiencies of greater than 15% could be achieved by more complex control strategies. (Cassar-PTT)
W89-12922

BIOMANIPULATION IN THE NETHERLANDS. APPLICATIONS IN FRESH-WATER ECOSYSTEMS AND ESTUARINE WATERS. AN INTRODUCTION.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
R. D. Gulati, and E. Van Donk.
Hydrobiological Bulletin HYBUD9, Vol. 23, No. 1, p 1-4, March 1989. 27 ref.

Descriptors: *Limnology, *Water quality control, *Lakes, *Estuaries, *Lake restoration, *Eutrophication, Ecosystems, The Netherlands, Food chains, Aquatic habitats, Habitats, Zooplankton.

The top-down approach to lake restoration features biomanipulation of the planktivorous fish, first, by mechanical eradication, then by enhancement of piscivore fish stocks. This encourages zooplankton numbers, which, in turn, reduces algae, improves light, favors macrophyte colonization, and makes a habitat suitable for predator fish. Although this technique does not have a long history in the Netherlands, several projects are currently underway in lakes and estuaries. (See also W89-12936) (Cassar-PTT)
W89-12935

BIOMANIPULATION, NEW PERSPECTIVES FOR RESTORATION OF SHALLOW, EUTROPHIC LAKES IN THE NETHERLANDS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
S. H. Hosper.
Hydrobiological Bulletin HYBUD9, Vol. 23, No. 1, p 5-10, March 1989. 2 fig, 32 ref.

Descriptors: *Limnology, *Water quality control, *Lakes, *Lake restoration, *Eutrophication, *Fish management, Ecosystems, The Netherlands, Food chains, Aquatic habitats, Habitats, Shallow lakes, Eutrophic lakes, Algae, Pike, Bream, Zooplankton.

Biomanipulation of shallow eutrophic lakes in the Netherlands involves an understanding of the food chains in these bodies of water. Algae are consumed by zooplankton, which in turn are eaten by young fish and mature fish of species such as bream and roach. Bream appears to be exceptionally successful in the turbid, eutrophic waters and reduces the zooplankton population, further increasing the algal biomass. Pike, which is a warm-water species requiring aquatic plant refuges, does not thrive in cool summers, allowing bream to increase dominance whenever summer temperatures are not optimal for pike. The objectives for lake restoration are clear water, rich littoral vegetation, and a strong pike population. One way of achieving these goals is to artificially reduce the bream population, which should increase zooplankton and reduce turbidity as an intermediate step. Young bream can be eliminated by fishing and by introduction of predator fish such as pike-perch and catfish if the macrophyte population is deficient and pike if macrophytes are available. Problems involve reintroduction of bream from connecting waters and continued loading of nutrients. (See also W89-12935) (Cassar-PTT)
W89-12936

FOOD WEB MANIPULATION IN LAKE ZWEMLUST. POSITIVE AND NEGATIVE EFFECTS DURING THE FIRST TWO YEARS.
Water Board of Utrecht (Netherlands).
E. Van Donk, R. D. Gulati, and M. P. Grimm.
Hydrobiological Bulletin HYBUD9, Vol. 23, No. 1, p 19-34, March 1989. 11 fig, 4 tab, 42 ref.

Descriptors: *Limnology, *Water quality control, *Lakes, *Lake restoration, *Eutrophication, *Fish management, Ecosystems, Lake Zwemlust, The Netherlands, Aquatic habitats, Habitats, Shallow lakes, Eutrophic lakes, Algae, Food chains, Zooplankton, Phytoplankton, Swimming, Pike, Rudd, Macrophytes, Aquatic plants, Snails, Invertebrates, Diseases, Nitrogen, Nutrients.

Hypertrophic Lake Zwemlust, used for swimming, was restored after Secchi disk measurements were much less than standards for swimming water. In March 1987 the lake was drained and the fish removed by seine-fishing and electro-fishing. After refilling by seepage, the lake was restocked by pike and rudd only. Stacks of willow twigs and macrophytes (Nuphar lutea and Chara globularis) were introduced to provide refuges for the pike. In the summer of 1987, in spite of high nutrient concentrations, the phytoplankton density was low, due to grazing by zooplankton, so that the Secchi disk transparency was about 2.5 m, the maximum depth of the lake. Chlorophyll a concentrations were <5 ug/liter, cyanobacteria blooms did not appear, and cladocerans predominated over rotifers. However, in 1988 some negative effects were noted. Macrophytes and filamentous green algae reached a higher biomass (50-60% cover of the lake bottom) than in the previous year and interfered with recreational use of the water. The snail population, including Lymnaea peregra var. ovata (a host for the swimmers' itch organism), developed on a large scale. Nevertheless, the macrophytes and filamentous green algae removed considerable nitrogen from the lake water, and phytoplankton was nitrogen-limited during the summer of 1988. In 1988 cladocerans were abundant in April only, and there was a shift from cladocerans to rotifers. (See also W89-12939) (Cassar-PTT)
W89-12938

STRUCTURE AND FEEDING ACTIVITIES OF ZOOPLANKTON COMMUNITY IN LAKE ZWEMLUST IN THE TWO YEARS AFTER BIOMANIPULATION.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
R. D. Gulati.
Hydrobiological Bulletin HYBUD9, Vol. 23, No. 1, p 35-48, March 1989. 8 fig, 3 tab, 39 ref.

Descriptors: *Limnology, *Water quality control, *Lakes, *Lake restoration, *Zooplankton, *Eutrophication, *Fish management, Ecosystems, Lake Zwemlust, The Netherlands, Food chains, Aquatic habitats, Habitats, Shallow lakes, Eutrophic lakes, Algae, Phytoplankton, Population dynamics, Bream, Rudd, Invertebrates, Nitrogen, Nutrients, Rotifers, Daphnia, Macrophytes, Aquatic plants.

The zooplankton community of eutrophic Lake Zwemlust in the Netherlands (1.5 ha; mean depth 1.5 m) was studied during a lake restoration project which involved complete drainage of water and removal of the fish (mainly bream) by netting and electrofishing. Willow twigs for shelter and spawning were fixed to the bottom before refilling the lake from the River Vecht. Fish introduced were 1500 pike fingerlings and 140 adult rudd. Daphnia magna and D. hyalina were also added. During the two years after the biomanipulation project, a classical pattern of succession was followed, with the rotifer spring maximum preceding the crustacean maximum by about 3 weeks. Among the Daphnia species, which appeared in quick succession during May to July, two were large-bodied forms (D. magna; D. pulex). Only D. pulex persisted; it was the most important grazer species during the second year, especially in spring. In the first year the crustacean grazing contributed significantly to the lake's improved water clarity, with Secchi disk transparencies of 1.5 m or more throughout the summer, compared with 0.3 m before the restoration project. Although light and nutrients were not limiting, the phytoplankton levels were an order of magnitude lower than before restoration. During the second year water clarity remained good, but the high macrophyte density (Chara, Elodea nuttali, and macroalgae) was the causal mechanism. Zooplankton density was considerably reduced by

rudd predation. The optimal light and nutrient conditions in the second year allowed development of a rich littoral biota. (See also W89-12938) (Cassar-PTT)
W89-12939

RESTORATION BY BIOMANIPULATION OF LAKE BLEISWIJKSE ZOOM (THE NETHERLANDS). FIRST RESULTS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
M. L. Meijer, A. P. Raat, and R. W. Doef.
Hydrobiological Bulletin HYBUD9, Vol. 23, No. 1, p 49-57, March 1989. 10 fig, 2 tab, 36 ref.

Descriptors: *Limnology, *Water quality control, *Lakes, *Lake restoration, *Zooplankton, *Eutrophication, *Fish management, Ecosystems, Lake Bleiswijkse, The Netherlands, Aquatic habitats, Habitats, Shallow lakes, Eutrophic lakes, Algae, Food chains, Phytoplankton, Population dynamics, Bream, Invertebrates, Nitrogen, Nutrients, Pike, Pikeperch, Carp, Predation, Macrophytes, Aquatic plants.

In 1987 eutrophic Lake Bleiswijkse Zoom (2 km long, 14.4 ha area, 1.1 m deep) was divided into two compartments to investigate the use of biomanipulation in restoring the water quality. The density of the fish stock before restoration was 650 kg/ha, mainly bream, white bream, and carp. Pikeperch was the main fish predator. In April 1987 all planktivorous bream and white bream and about 85% of the benthivorous bream and carp were removed from the Galgje compartment of the lake. Advanced pikeperch fry were introduced as predators. The Zeeltje compartment was used as a control. Removal of the fish resulted in low concentrations of chlorophyll a, total phosphorus, nitrogen, and suspended solids. These conditions increased the Secchi disk transparency from 20 to 110 cm. Within two months after removal of the fish, macrophytes (mainly Characeae) became abundant. Low algal biomass prevailed until July because of heavy zooplankton grazing. When the zooplankton densities decreased, starting in June, algal concentrations remained low, probably a result of nutrient limitation and competing algal growth. The fish biomass after treatment was 220 kg/ha in the treated compartment and 650 kg/ha in the untreated compartment. The number of fish species was higher in the treated compartment. (Cassar-PTT)
W89-12940

NORTHERN PIKE (ESOX LUCIUS L.) AND AQUATIC VEGETATION, TOOLS IN THE MANAGEMENT OF FISHERIES AND WATER QUALITY IN SHALLOW WATERS.
Organization for the Improvement of Inland Fisheries, P.O. Box 433, 3430 AK Nieuwegein, The Netherlands.
M. P. Grimm.
Hydrobiological Bulletin HYBUD9, Vol. 23, No. 1, p 59-65, March 1989. 2 fig, 3 tab, 22 ref.

Descriptors: *Limnology, *Water quality control, *Lakes, *Lake restoration, *Fish management, *Eutrophication, *Aquatic plants, Pike, Bream, Carp, Ecosystems, The Netherlands, Aquatic habitats, Habitats, Shallow lakes, Eutrophic lakes, Fish management, Algae, Food chains, Phytoplankton, Population dynamics, Predation.

Relationships between the species and size composition of fish communities and vegetation type, abundance, and patterns were studied in 9 shallow, eutrophic lakes in the Netherlands. Irreversible changes in the aquatic ecosystem were induced by eutrophication and by efforts to manage the water for recreational fishing and improve trophic status. Surface vegetated areas ranged from 1% to about 95%. Heavily vegetated lakes had fish communities composed of pike, tench, and rudd; intermediately vegetated lakes contained mostly roach, white bream, perch, and eel; sparsely vegetated waters were populated by bream, white bream, and carp. Eutrophication affects fish populations in the following ways. (1) Increased nutrient loads change the species composition of the submerged vegetation and decrease the total area. This increases cyprinids and pike biomass. (2) Continued eutrophication causes further collapse of the vegetation system, increases algal biomass, increases predation on herbivorous zooplankton, and promotes the pike population. (3) The activity of the bottom-feeding carp and bream releases further nutrient release from the sediments. (4) In waters with small ratios of shore length to surface area, disappearance of submerged vegetation produces excessive recruitment of small cyprinids, including young bream, which stir up large quantities of sediment and release nutrients into the water. Blooms of blue-green algae are favored by these conditions. Four types of stagnant, eutrophic waters, classified according to fish population, are described, as well as the effects of nutrient loading reductions in each case. Fish management suggestions are given for each type of ecosystem. (Cassar-PTT)
W89-12941

ALTERNATIVE STABLE STATES IN EUTROPHIC, SHALLOW FRESHWATER SYSTEMS. A MINIMAL MODEL.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
M. Scheffer.
Hydrobiological Bulletin HYBUD9, Vol. 23, No. 1, p 73-83, March 1989. 12 fig, 36 ref.

Descriptors: *Limnology, *Water quality control, *Lakes, *Lake restoration, *Eutrophication, *Model studies, *Nutrients, Ecosystems, Mathematical models, Food chains, Aquatic habitats, Habitats, Shallow lakes, Eutrophic lakes, Fish management, Population dynamics, Bream, Pike, Oligotrophic lakes.

A simple mathematical model was constructed, describing the relationship between pike, bream, aquatic macrophytes and the nutrient loading of shallow lakes. The model was analyzed using zero isoclines. It was concluded that, over a certain range of nutrient concentrations, the ecological relations incorporated in the model can give rise to the existence of two alternative stable equilibria; viz. a turbid bream-dominated one, and a clear stage in which pike and aquatic vegetation are abundant. Under oligotrophic conditions, the clear-water state presents the only stable equilibrium; however, at high nutrient levels, the clear state is absent, or only locally stable. The response of the model to both increase and decrease of the nutrient level is characterized by hysteresis. The results indicate that manipulation of fish densities as a measure to improve water quality is only likely to produce long-term results when the nutrient level is below a certain threshold. (Author's abstract)
W89-12943

ACTIVE BIOLOGICAL SLUICE MANAGEMENT IN LAKE GREVELINGEN.
W. Oorthuysen, and C. W. Iedema.
Hydrobiological Bulletin HYBUD9, Vol. 23, No. 1, p 85-89, March 1989. 1 fig, 1 tab, 11 ref.

Descriptors: *Water quality control, *Lakes, Saline lakes, Lake Grevelingen, The Netherlands, Water management, Stratification, Ecosystems, Sluices, Marine environment.

Water management methods for Lake Grevelingen, The Netherlands, are presented. This lake is an artificially formed salt water body with a fixed water level, currently managed by opening one sluice from October 1 to the end of February and closing it from March 1 to the end of September. Objectives of the management plan are a high salinity level (>16 g Cl/liter), minimum stratification, maintenance of high transparency, and a health ecosystem. Two viewpoints on management have developed. The first sees the lake as a subsystem of the North Sea, in which the sluice is kept open year-round, allowing free communication of marine organisms and salt water. In 1979, when the sluice remained open during the whole year, plaice and flounder increased and microalgal fluctuations were stabilized. The second viewpoint sees the lake as an independent ecosystem with minimum communication with the North Sea. This would reduce salt content and stress on marine organisms. Further research is required to assess all the impacts of these two management strategies. (Cassar-PTT)
W89-12944

ASSESSING THE VALUE OF HYDROGEOLOGIC INFORMATION FOR RISK-BASED REMEDIAL ACTION DECISIONS.
Harvard School of Public Health, Boston, MA. Program in Environmental Health and Public Policy.
E. G. Reichard, and J. S. Evans.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1451-1460, July 1989. 4 fig, 5 tab, 44 ref, append. EPA Cooperative Agreement CR-812-699.

Descriptors: *Water pollution treatment, *Risk assessment, *Groundwater pollution, *Cost analysis, Monitoring, Probability distribution, Population exposure, Economic aspects.

Remedial action decisions for groundwater contamination are made under conditions of uncertainty regarding both human exposure levels and chemical potency. The value of groundwater monitoring in reducing exposure uncertainty can be estimated within a decision-analytic framework. The value of information from a particular monitoring strategy will depend on the expected accuracy of the strategy in estimating exposure, prior uncertainty about exposure and potency, the costs and efficiencies of the alternative remedial actions, and values assumed for the discount rate and the cost/unit risk. The proposed framework for assessing the value of hydrogeologic information at a groundwater contamination site consists of three steps: (1) determine a probability distribution for average lifetime exposure; (2) estimate the value of perfect exposure information in reducing the expected opportunity losses of decision making; and (3) compare hydrogeologic monitoring costs with the expected value of the sample information provided. (Author's abstract)
W89-12972

CONTROLLING SEEPAGE FROM EVAPORATION PONDS.
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. E. Grismer.
California Agriculture CAGRA3, Vol. 43, No. 1, p 21-22, January-February 1989. 2 fig.

Descriptors: *Seepage control, *Water pollution control, *Waste disposal, *Evaporation ponds, *Hydraulics, *Evaporation, *Seepage, *Ponds, *Drainage, Impervious boundaries, Subsurface drainage, Toxicity, Water pollution control, Drain spacing, Seepage loss, Drainage practices.

The question of whether subsurface drainlines beneath evaporation ponds could recover seepage losses and possibly avoid the need for liners was investigated. Seepage of potentially toxic materials from drainage water evaporation ponds may be controlled in part by subsurface drainlines directly below the pond. The extent to which the drainlines recover seepage depends on the area of the pond, soil permeabilities below the pond, and the number and spacing of drainlines. For ponds on soils favoring flows in the horizontal direction, bounded by a more slowly permeable clay layer at the bottom, seepage control by subsurface drainlines can be very effective. For hydrogeologic conditions characteristic of the west side of the San Joaquin Valley, subsurface drainage at a spacing of approximately 10% of the pond width should recover over 90% of seepage losses that would occur if the pond had only perimeter drains. The net volume of seepage losses depends on soil permeability at the site. Finally, if the subsurface drains are to be effective in recovering seepage losses, drainlines and sump pumps must be of adequate capacity to carry anticipated flows. (Miller-PTT)
W89-13044

ENVIRONMENTAL PROTECTION - A PERMANENT CHALLENGE (UNWELTSCHUTZ - EINE STANDIGE HERAUSFORDERUNG).

Bayer A.G., Leverkusen (Germany, F.R.).
M. Zlokarnik.
Chemie-Ingenieur-Technik CITEAH, Vol. 61, No. 5, p 378-385, May 1989. 10 fig, 2 tab, 29 ref.

Descriptors: *Water quality, *Environmental protection, *Industrial development, *Urbanization, Wastewater treatment, Pollutants, Municipal wastewater.

Through the intensive investment activity of municipalities and of the chemical and related industries in the past twenty years, it has been possible to greatly reduce the extent of environmental pollution which arose as a result of the rapid urban expansion and industrialization of the 1950s and 1960s. However, a more thorough protection of river and sea waters cannot be achieved merely through the further sophistication of waste-water technologies. More importantly, every possibility for reducing the quantity and pollutant content of waste-water must be fully exploited. Such possibilities lie in the recycling of processing water, in the integration of environmental protection into the process itself, as well as in the appropriate redesign and modification of the processes. The various fields of activity, especially those particularly rewarding to the process engineer are examined and numerous possible directions are offered. Six technical examples, which have been applied in practice, serve as illustration. (Author's abstract)
W89-13045

EVALUATION OF NORTH CAROLINA'S ESTUARINE SHORELINE AREA OF ENVIRONMENTAL CONCERN FROM A WATER QUALITY PERSPECTIVE.

East Carolina Univ., Greenville, NC. Dept. of Geography and Planning.
J. D. Phillips.
Coastal Management CZMJBF, Vol. 17, No. 2, p 103-117, 1989. 1 fig, 4 tab, 26 ref, append.

Descriptors: *Zoning, *Environmental policy, *Nonpoint pollution sources, *Water quality, *North Carolina, *Estuaries, *Shores, Development, Hydrologic models, Coastal zone management, Permits.

Nonpoint source pollution from estuarine shoreline development is a major water quality issue in North Carolina. The state's Coastal Area Management Act includes an 'estuarine shoreline area of Environmental Concern' (AEC) where land-disturbing activities are subject to permitting. The estuarine shoreline AEC extends inland 75 feet (23 m) from the mean high water mark, providing an incentive to maintain vegetated buffers (to avoid permit requirements) and giving the state some control over nearshore activities. But this 23-meter buffer may not be sufficiently wide for protecting water quality. A hydrologic model that measures the ability of a buffer zone to detain polluted stormwater is applied in the state's Carteret County. Results show that for typical residential and commercial development, 23 m provides an inadequate width for filtering polluted runoff. This suggests that the dimensions of the estuarine shoreline AEC should be expanded if it is to be an effective tool for protecting estuarine water quality. A width of 80 m is recommended. (Author's abstract)
W89-13047

AQUACULTURE AND COASTAL ZONE MANAGEMENT IN BANGLADESH.

Universidad de Oriente, Cumana (Venezuela). Inst. Oceanografico.
For primary bibliographic entry see Field 8I.
W89-13048

TWO DIMENSIONAL NUMERICAL MODELING OF HYDRODYNAMICS AND POLLUTANT TRANSPORT IN A WET DETENTION POND.

Virginia Univ., Charlottesville. Dept. of Civil Engineering.
D. E. Benelmouffok, and S. L. Yu.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 727-738, 1989. 15 fig, 2 tab, 3 ref.

Descriptors: *Hydrodynamics, *Urban runoff, *Storm runoff, *Detention reservoirs, *Water pollution control, *Path of pollutants, *Model studies, *Ponds, Hydrologic models, Flow, Differential equations, Mathematical studies, Virginia.

A vertically-averaged two-dimensional hydrodynamic model was developed to simulate water movements in a small, shallow, unstratified impoundment. The hydrodynamic model was then coupled with a two-dimensional pollutant transport model to calculate the mass fluxes of pollutant. The differential equations were numerically solved on a space staggered grid using a two-level time ADI integration scheme. The model was used to simulate the flow and pollutant transport and to assess the pollutant removal performance of an urban detention pond located in Charlottesville, VA. Results of the simulation were compared to field data taken at the site. The model was successfully utilized in simulating pollutant transport and trapping, making it useful in analyzing wet detention pond modification for urban pollution control. (Author's abstract)
W89-13050

HYDRAULIC PERFORMANCE AND CONTROL OF POLLUTANTS DISCHARGED FROM A COMBINED SEWER STORAGE OVERFLOW.

Manchester Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-13052

URBAN STORMWATER REDUCTION AND QUALITY IMPROVEMENT THROUGH THE USE OF PERMEABLE PAVEMENTS.

Trent Polytechnic, Nottingham (England). Dept. of Civil and Structural Engineering.
For primary bibliographic entry see Field 4A.
W89-13054

RIVER QUALITY MODELS FOR CONSENT SETTING IN ENGLAND AND WALES.

WRC Engineering, Swindon (England).
For primary bibliographic entry see Field 5B.
W89-13077

APPLICATION OF EXPERT SYSTEMS TECHNOLOGY IN WATER QUALITY MODELING.

Environmental Protection Agency, Athens, GA.
For primary bibliographic entry see Field 7C.
W89-13080

HEURISTIC ALGORITHMS FOR WASTE LOAD ALLOCATION IN A RIVER BASIN.

Indian Inst. of Tech., Bombay. Centre for Environmental Science and Engineering.
V. Joshi, and P. Modak.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 1057-1064, 1989. 2 fig, 8 tab, 6 ref.

Descriptors: *Pollution load, *Water quality management, *Waste load allocation, *River basins, *Waste disposal, *Mathematical studies, *Algorithms, Computer programs, Hueristic algorithms, Decision making, Dynamic programming.

Waste load allocation for rivers has been a topic of growing interest. Dynamic programming based algorithms are particularly attractive in this context and are widely reported in the literature. Codes developed for dynamic programming are complex, require substantial computer resources and do not allow interactions of the user. Further, there is always resistance to utilizing mathematical programming based algorithms practice in systems analysis in water quality management. Various heuristic algorithms are presented to bridge this gap with supporting comparisons with dynamic programming-based algorithms. These heuristics make good use of the insight gained in the system's behavior through experience, a process akin to the one adopted by field personnel and, therefore, can readily be understood by a user familiar with the system. Also, they allow the user preferences in decision-making via on-line interaction. Experience has shown that these heuristics are indeed well-founded and compare favorably with the sophisticated dynamic programming algorithms. Two examples have been included which demonstrate such a success of the heuristic algorithms. (Author's abstract)
W89-13081

RIVER CATCHMENT MANAGEMENT: AN APPROACH TO THE DERIVATION OF QUALITY STANDARDS FOR FARM POLLUTION AND STORM SEWAGE DISCHARGES.

Water Research Centre, Medmenham (England).
K. Whitelaw, and J. F. deSolbe.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 1065-1076, 1989. 11 fig, 1 tab, 30 ref.

Descriptors: *River basins, *Catchment areas, *Water pollution control, *Watershed management, *Water quality standards, *Water quality, *Storm-overflow sewers, *Farm wastes, Water pollution effects, Toxicity, Median tolerance limit, Case studies, Bioassay, Sublethal effects, Statistical analysis, Mortality, Salmon, Carp, Pike, Perch, Trout.

Water quality in certain United Kingdom rivers has deteriorated due to episodic pollution from farms and storm sewage overflows. In response to the need to further our knowledge of the effects of episodic events on water quality and to derive appropriate quality standards, WRc Environment has established a number of case studies involving both field and laboratory investigations. Two complementary approaches are used: (1) one based on examining toxicity data in order to derive working draft standards, and (2) the other based on the testing of these draft standards against the performance of living organisms. A search of published LC50 data was carried out and a comparison was made between the results of different experiments. The corrected data were then plotted as toxicity curves for a variety of toxicants and for salmonids, cyprinids, pike and perch. From these toxicity curves, it is possible to draw in proposed LC50 standards, approximating to the lowest LC50 values at all times. In setting standards, the aim is to determine the highest concentration of the toxicant which will not be harmful to the fish. Ideally, this concentration (LCO) would be used instead of LC50s. Unfortunately, it is virtually impossible to measure LCOs with any accuracy because even the first death in a batch of, say, ten fish is statistically far less reliable than the death of the fifth or sixth fish, as the confidence limits about the estimated median death are much narrower. Therefore, the LC20 may be more suitable as a standard because it approaches the LCO but is statistically more reliable. The proposed LC50 standards can be converted to LC20 standards by considering the LC20:LC50 ratio. This method can be used to determine whether a given pollution event exceeds the overall standard. (Miller-PTT)
W89-13082

SCHEMES OF IMPROVING THE SANITARY AND ENGINEERING STATE AND USE OF MULTIPURPOSE RESERVOIRS.

L. N. Shapiro, and V. A. Sharapov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 10, p 613-615, April 1989. 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 48-50, October 1988.

Descriptors: *USSR, *Water quality control, *Reservoirs, Management planning, Public health, Flood plain zoning, Lake shores, Erosion control, Watershed management, Fisheries, Agriculture, Economic aspects.

Possibilities for improving the engineering state and amenities were investigated in the Volga-Kama and Dnepr cascades (Soviet Union) and some other areas. Common problems in the examined reservoirs were: unsatisfactory sanitary and hygienic conditions (except for several Dnepr res-

ervoirs), poor state of many engineering structures, and lack of efficient use of water and the potential biological resources of the reservoirs. Among the measures deemed important for correcting these problems were: creation around reservoirs of a shore-water protection zone and within that a shore-water protection strip; undertaking of water protection measures (e.g., erosion control, scientific farming practices, forest improvement, and hydraulic engineering); use of treatment plants at enterprises, in cities, and in populated rural areas; construction and reconstruction of engineering protection structures that are needed to improve sanitary and amenity conditions in the shore area; and expanded appropriate use of the shoal areas of reservoirs, such as in fisheries or in the recovery of vegetative matter for animal feed (hay). Two major problems exist for any attempt to implement these measures: (1) various ministries and agencies must make investments in water-protection measures that they are not accustomed to making and (2) the ecology of reservoirs, particularly as it relates to biological productivity, is not well understood. (Rochester-PTT)
W89-13108

INFLUENCE OF VESSEL MOVEMENTS ON STABILITY OF RESTRICTED CHANNELS.
Louisiana Ports and Waterways Inst., Baton Rouge, LA.
For primary bibliographic entry see Field 2J.
W89-13121

MANAGEMENT OF PHOSPHORUS AND NITROGEN INPUTS TO LAKE ROTORUA, NEW ZEALAND.
Department of Scientific and Industrial Research, Hamilton (New Zealand). Water Quality Centre.
J. C. Rutherford, R. D. Pridmore, and E. White.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 4, p 431-439, July 1989. 3 fig, 1 tab, 18 ref.

Descriptors: *Limnology, *New Zealand, *Eutrophication, *Water quality control, *Lake restoration, Limiting nutrients, Phosphorus, Nitrogen, Cyanophyta, Nitrogen fixation, Nuisance algae, Lake Rotorua, Phytoplankton, Recreation.

The water quality of Lake Rotorua has deteriorated since the 1960s because of excessive phytoplankton growths caused by increased inputs of phosphorus and nitrogen from the Rotorua city sewage treatment plant. Removal of phosphorus alone may produce no measurable improvement in lake condition unless it can be made the limiting nutrient. Even then, this may take a number of years because of recycling of phosphorus already in the lake system. Removal of nitrogen alone may reduce phytoplankton growth in the short term (say 5-10 yr), but is not recommended because the algal community may become dominated by heterocystous blue-green algae, which can meet their nitrogen requirements by fixing dissolved molecular nitrogen, and which form dense, unsightly assemblages. Thus, removal of both nitrogen and phosphorus is recommended. A suggested aim is to restore the lake condition to that which prevailed prior to the 1960s, before widespread concern about phytoplankton growths developed. The scientific view is that this lake condition is achievable and will reduce the frequency and magnitude of nuisance algal blooms, maintain reasonable water appearance and clarity for recreational purposes, minimize periods of deoxygenation, and reduce internal nutrient inputs. Removal of all sewage effluent from the catchment is expected to achieve the nutrient load reduction that is required. Any sewage discharge increases the risk that the lake condition will be unsatisfactory, but this risk probably is low if the sewage inputs are less than 3 tonnes (t) of phosphorus and 30 t of nitrogen per year. (Author's abstract)
W89-13124

THREE-DIMENSIONAL MIXING CELL SOLUTE TRANSPORT MODEL AND ITS APPLICATION.
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 2F.
W89-13165

WASTE STABILIZATION IN MULTILAYER AQUIFERS BY OPTIMAL HYDRAULIC CONTROL.
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
M. M. Aral.
Ground Water GRWAAP, Vol. 27, No. 4, p 517-523, July-August, 1989. 7 fig, 9 ref.

Descriptors: *Injection wells, *Water pollution control, *Aquifer systems, *Path of pollutants, Model studies, Recharge wells, Waste management, Hydraulic gradient.

Migration of contaminant plumes in aquifer systems can be controlled by producing desired changes in local flow rates and hydraulic gradients through the use of pumping and recharge wells. Such management scenarios have been used in the past for controlled operations in main aquifers. It is also possible to describe similar control procedures for multilayer aquifer systems. In these applications the migration of contaminant plumes in one layer may be controlled through the use of pumping and recharge wells in other layers which control the hydraulic gradients in the contaminated aquifer. In such applications the contaminated aquifer will not be interfered with and hydraulic gradient control operations will be performed on adjacent aquifer layers avoiding direct contact with the contamination source. Such operations may prove useful in case of hazardous waste management. In the study discussed here, mathematical preliminaries of the models utilized in this type of an operation are reviewed, and the effects of management scenarios are discussed for a typical aquifer considering only the hydraulic control aspects of the management process. Management procedures which incorporate the contaminant transport process and operational costs optimization processes into the analysis are not the subject matter of this study. (Author's abstract)
W89-13166

HAZARDOUS WASTE SITE MANAGEMENT: WATER QUALITY ISSUES.
For primary bibliographic entry see Field 5E.
W89-13198

SETTING ENVIRONMENTAL STANDARDS FOR HAZARDOUS WASTE SITES: A BREAK FROM THE PAST OR A CONTINUUM.
Dowd (R.M.) and Co., Washington, DC.
For primary bibliographic entry see Field 5E.
W89-13199

ESTABLISHING AND MEETING GROUND WATER PROTECTION GOALS IN THE SUPERFUND PROGRAM.
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5E.
W89-13200

SOME APPROACHES TO SETTING CLEANUP GOALS AT HAZARDOUS WASTE SITES.
H. S. Brown.
IN: Hazardous Waste Site Management: Water Quality Issues. National Academy Press. Washington, DC. 1988. p 34-65, 4 tab, 2 fig, 9 ref.

Descriptors: *Waste dumps, *Hazardous materials, *Waste management, *Environmental policy, *Regulations, *Standards, *Cleanup, Water law, Legislation, Fate of pollutants, Legal aspects, Federal jurisdiction, State jurisdiction, Contamination, Toxins, Carcinogens, Risk assessment, Risk management.

Hazard management at waste sites is more complex than at other locations because it involves multiple pathways of exposure. This paper reviews the work of the following agencies: U.S. Environmental Protection Agency, U.S. Army, California Department of Health Services, Washington State Department of Ecology, and the New Jersey Department of Environmental Protection. All of the methods focus on the protection of public health from the adverse effects of exposure to single toxicants as well as their mixtures, through single or multiple routes of exposure. The most favored approach to defining 'How clean is clean' for hazardous waste sites is that based on chemical-/media-specific numerical ambient acceptable concentrations for specific toxic materials. These criteria are derived separately for substances with and without carcinogenic properties, a practice consistent with many past experiences in regulating air and water contaminants. The rational used by each method to derive these health-based numbers, however, is unique to each method. The confusion in the diverse terminology is the least of the problems. The most serious differences stem from variations in the basic assumptions about the environmental fate of chemicals, stringency of application of principles of toxicology, data base, use of existing standards/guidelines, use of safety factors, interconversion among routes of human exposure, acceptability of cancer risk, and extent of reliance on expert judgment. Because of this diversity, acceptable ambient concentrations derived by one method are not comparable with those from another and the adoption of numbers derived through one method for use by another is inappropriate. Although the current emphasis is on the separation of risk assessment from risk management, none of the five methodologies succeeds in making this separation. The practice of converting the existing numbers into chemical-/media-specific criteria, the need to simplify the complex scenarios, and the need to fill the lack of data with assumptions make it clear that the separation, however desirable, cannot be maintained. (See also W89-13198) (Hammond-PTT)
W89-13201

CALIFORNIA SITE MITIGATION DECISION TREE PROCESS: SOLVING THE 'HOW CLEAN SHOULD CLEAN BE' DILEMMA.
California Dept. of Health Services, Sacramento.
For primary bibliographic entry see Field 5E.
W89-13202

HOW CLEAN IS CLEAN: THE NEED FOR ACTION.
General Electric Co., Fairfield, CT.
T. M. Hellman, and D. A. Hawkins.
IN: Hazardous Waste Site Management: Water Quality Issues. National Academy Press. Washington, DC. 1988. p 98-107, 4 tab, 1 ref.

Descriptors: *Regulations, *Legislation, *Legal aspects, *Cleanup, *Environmental policy, *Water law, *Waste management, *Public policy, Conservation, Water pollution control, Water quality control, Standards, State jurisdiction, Federal jurisdiction, Superfund, Remedies, Economic aspects, Soil contamination, Public participation, Groundwater pollution, Administrative agencies, Risk assessment, Public health.

According to the Environmental Protection Agency a cleanup conducted under the Resource Conservation and Recovery Act's corrective action authority should be no different from a cleanup undertaken under the Superfund program. Both target the cleanup of historic contamination, and have the same health-based cleanup goals. One significant difference is that the Resource Conservation and Recovery Act sites are generally associated with existing business whose operating revenues can be used to pay for the cleanup. The funds available for Superfund sites are more limited. The Environmental Protection Agency also has announced its intent to merge the Resource Conservation and Recovery Act and Superfund cleanup approaches, creating a single programmatic response to the cleanup of historic contamination. The choice of undertaking a cleanup under the authority of the Resource Conservation and Recovery Act or Superfund is, however, an important one. The recent enactment of the Superfund Amendments and Reauthorization Act has sharpened their differences. The statutes adopt divergent approaches on critical issues such as cleanup standards, use of alternative concentration limits,

cost-effectiveness, and public participation. Complementing the federal statutes, state often have a form of Superfund law, requiring the cleanup of sites not addressed by the federal Superfund. The overall impact of the Superfund Amendments and Reauthorization Act has caused the Environmental Protection Agency staff to project a 9-month increase for handling a Superfund cleanup. This increase, new cleanup standards, health assessments, state and public participation, all contribute to the potential for increased cost. The cleanup problems can be analyzed in terms of three major technology challenges: concentrated residues; contaminated groundwater; and contaminated soil. Although there are technological challenges, for example, the cleanup of contaminated soils, the possibility of cleaning up fewer sites or creating future liabilities because of more stringent standards also must be evaluated. The Environmental Protection Agency should use an overall risk assessment to determine what action represents the greatest risk reduction potential per dollar spent. (See also W89-13198) (Hammond-PTT)
W89-13203

HOW CLEAN IS CLEAN: AN ENVIRONMENTALIST PERSPECTIVE.
Environmental Defense Fund, Washington, DC.
L. E. Greer.
IN: Hazardous Waste Site Management: Water Quality Issues. National Academy Press. Washington, DC. 1988. p 110-118.

Descriptors: *Cleanup, *Environmental protection, *Water pollution treatment, *Water quality control, *Environmental policy, *Regulations, *Water law, *Legal aspects, *Legislation, Federal jurisdiction, State jurisdiction, Waste management, Standards, Economic aspects, Decision making, Public health, Cost analysis, Superfund, Public health.

There has been considerable dissatisfaction on the part of community and environmental groups concerning the 'how clean is clean' decisions made by the Environmental Protection Agency. The decisions made so far have been inconsistent and have not always been adequate to protect human health and the environment. The national environmental groups have expended a great deal of time and money to improve the language of the Superfund legislation and redirect the Environmental Protection Agency. As a result of successful work by the environmental lobby, the 1986 reauthorized Superfund requires the use of all relevant and appropriate standards and criteria in establishing nationwide levels of cleanup. The law explicitly directs the Environmental Protection Agency to use requirements established by all federal environmental legislation, including the Toxic Substances Control Act; the Safe Drinking Water Act; the Clean Air Act; the Clean Water Act; the Marine Protection, Research, and Sanctuaries Act; and the Solid Waste Disposal Act. The laws to be applied also include any state environmental requirement that is more stringent than a comparable federal requirement, including state requirements where there is no comparable federal requirement. Furthermore, the environmental lobby obtained new statutory language on the role of cost in making both cleanup and technology decisions. As of the end of 1986, an analysis of cost-effectiveness can begin only after a remedial action has been selected in compliance with health and environmental protection requirements as well as permanent treatment requirements. Thus, cost will not play a role in the selection of the correct course of cleanup action; rather, it will come into play only after the cleanup strategy has been selected. The next five years should show the improvements from these legislative changes in regulation, guidance documents, and at the Superfund sites themselves. (See also W89-13198) (Hammond-PTT)
W89-13204

GROUND WATER CONTAMINATION ISSUES IN SANTA CLARA COUNTY, CALIFORNIA: A PERSPECTIVE.
Santa Clara Valley Water District, San Jose, CA.
R. R. Esau, and D. J. Chesterman.
IN: Hazardous Waste Site Management: Water Quality Issues. National Academy Press. Washington, DC. 1988. p 120-136, 1 fig, 7 ref.

Descriptors: *California, *Groundwater pollution, *Water quality control, *Regulations, *Environmental policy, *Cleanup, Hazardous materials, Public policy, Economic aspects, Contamination, Freon, Trichloroethylene, Carbon tetrachloride, Source of pollutants, Risk assessment, Public health, Governmental interrelations, Local governments.

The Santa Clara Valley Water District, as a wholesaler of water and the management agency of the groundwater basin, has a responsibility to ensure that the basin remains usable as an important element of the water supply in Santa Clara County. Recent contamination, trichloroethylene and freon 113 from IBM, trichloroethylene from the Fairchild Camera and Instrument Corporation, and a 400-foot-deep standby well owned by the California Water Service Company tainted with carbon tetrachloride, has threatened that vital resource. In response, regulatory agencies involved in cleaning up past contamination have sorted out their respective roles, and an effective working relationship has evolved. IBM and Fairchild have adopted active approaches, defining the boundaries of the plume of contamination and proceeding with interim cleanup efforts. Because the source of contamination is unknown, the California Water Service Company has adopted a passive approach by air stripping the well water at the wellhead. The consensus of the affected parties, including the public, the retailers, and the Santa Clara Valley Water District, has been that the passive approach is only acceptable when the source of the contamination is unknown. In their oversight responsibilities the regulatory agencies are faced with difficult decisions with respect to ultimate cleanup objectives. The Bay Regional Board, as a lead agency in cleanup oversight activities, has forged an effective policy for determining cleanup objectives. It considers economic, technical, and public health risk factors in a process aimed at achieving a cost-effective cleanup that is safe and acceptable to the public. Funding for the increasing number of contamination cases being discovered is a growing problem in Santa Clara County. Hundreds of fuel leaks have received little or no oversight due to understaffing in regulatory agencies. As a result, these cases are receiving an unknown level of cleanup effort from facility owners who may not have the technical and financial means to address these problems adequately. (See also W89-13198) (Hammond-PTT)
W89-13205

USING MODELS TO SOLVE GROUND WATER QUALITY PROBLEMS.
J. M. Davidson, and P. S. C. Rao.
IN: Hazardous Waste Site Management: Water Quality Issues. National Academy Press. Washington, DC. 1988. p 139-149, 17 ref.

Descriptors: *Water quality control, *Groundwater pollution, *Model studies, *Regulations, *Environmental policy, Contamination, Standards, Toxins, Mathematical models, Fate of pollutants, Federal jurisdiction, Calibrations, Wastewater disposal, Hazardous materials.

Mathematical models for describing the fate and transport of water and toxic chemicals in porous media and numerical ranking schemes for assessing site vulnerability and contamination potential, although not satisfactorily validated to date, appear to have a guarded role in policy making, the development of environmental regulations, and the establishment of remedial actions for regulatory agencies responsible for groundwater. The models should not, however, be used without some monitoring effort for the purpose of validation and/or calibration. The extent to which such efforts are conducted will depend on the purpose of the model as well as the areal extent to which the model is expected to be representative. In 1984, the Environmental Protection Agency Order 5360.1, 'Policy and Program Requirements to Implement the Mandatory Quality Assurance Program,' was issued, providing the first regulatory basis for the agency's quality assurance program. Quality assurance is the procedural and operating structure required in model development to ensure technical execution of all aspects of the model. The Environmental Protection Agency's groundwater modeling quality assurance program's goal is to ensure that all the supported modeling efforts are of a known and scientifically acceptable quality in terms of computer code, documentation, and operation. The alternative to modeling is one of reaction through an extensive soil and groundwater monitoring program, a position that is not realistic if pristine groundwater conditions are the anticipated goal. The release of a chemical to the soil surface will eventually result in some portion of it reaching the groundwater, be it a large concentration or a very low concentration. Such attenuation results from degradation, sorption, and volatilization. Complete chemical containment or stabilization is the only waste disposal procedure currently available that provides groundwater protection; yet even these procedures are subject to engineering failures. (See also W89-13198) (Hammond-PTT)
W89-13206

ESTIMATING HEALTH RISKS AT HAZARDOUS WASTE SITES: DECISIONS AND CHOICES DESPITE UNCERTAINTY.
ENVIRON Corp., Washington, DC.
R. G. Tardiff, and M. Gough.
IN: Hazardous Waste Site Management: Water Quality Issues. National Academy Press. Washington, DC. 1988. p 152-174, 4 tab, 1 fig, 6 ref.

Descriptors: *Public health, *Waste dumps, *Uncertainty, *Hazardous materials, *Water quality control, *Environmental policy, *Decision making, *Risk assessment, Groundwater pollution, Safety, Waste management, Contamination, Carcinogens, Toxicity.

Quantitative risk assessment is the only method currently available to estimate risks from waste sites. Both the underlying data about toxicity and methods for extrapolation have greater or lesser amounts of uncertainty. The demands of risk assessment are forcing the development of standardized data bases for health effects; they are also contributing to the development of extrapolation methods. Nevertheless, uncertainties must always be considered and conveyed to the decisionmaker so that the strengths and limitations of the risk estimates are appropriately considered in selecting risk management approaches. The most pressing need is for more biologic information to guide extrapolation methods. In part, that information will come from standard toxicologic tests of substances present in waste sites, but more fundamental research is probably the real key to improvement. Along with such data will come increasing opportunities for interactions among biologists, statisticians, risk assessors, and decision makers. (See also W89-13198) (Hammond-PTT)
W89-13207

WATER QUALITY 88: SEMINAR PROCEEDINGS.
Hydrologic Engineering Center, Davis, CA.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A98 648. Price codes: A18 in paper copy, A01 in microfiche. February 23-25, 1988, Charleston, South Carolina. (1988). 424p. Edited by R. G. Willey.

Descriptors: *Water quality, *Conferences, *Reservoirs, *Estuaries, Coastal waters, Water quality control, Rivers, Case studies.

A three-day seminar was held to provide a forum for Corps of Engineers personnel who are routinely involved in water quality and water control work. The seminar was co-sponsored by the Hydrologic Engineering Center and the Committee on Water Quality. Twenty-one papers on Reservoir and Riverine Case Studies and sixteen papers on Coastal and Estuarine Case Studies which were presented at the seminar are included in these proceedings. An appendix is also included which contains ten abstracts by those displaying materials

during the poster session. (See W89-13232 thru W89-13268) (Lantz-PTT)
W89-13231

WATER QUALITY MANAGEMENT FOR RESERVOIRS AND TAILWATERS: A WOTS DEMONSTRATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
R. H. Kennedy, R. C. Gunkel, and R. F. Gaugush.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 2-8, 6 fig, 4 ref.

Descriptors: *Water quality management, *Reservoir operation, *Tailwater, Management planning, Decision making, Data interpretation.

As a continuing effort, the Corps of Engineers (CE) has established the Water Operations Technical Support (WOTS) Program as a means of maintaining and distributing water quality information and technology. A recent addition to the WOTS Program has been the Water Quality Management for Reservoirs and Tailwaters (WQMRT) Demonstration initiated in 1987. A major objective of WQMRT is the formulation of a protocol for addressing water quality management issues and identifying appropriate mitigating methodologies. The development of a management protocol requires decision making which progresses in an orderly, directed fashion following clearly defined and interrelated steps. These steps, the definition of which is independent of the nature of the problem addressed, logically lead the manager from problem identification to problem solution. The six basic steps in this process, which are expanded in this paper, are: (1) identification of issues; (2) collection and analysis of data; (3) formulation of management goals and objectives; (4) evaluation of management alternatives; (5) implementation of the selected alternative(s); and (6) post-implementation evaluation. The WQMRT Demonstration represents the CE's first, major effort to develop a sound protocol for the CE-wide management of its water resource enhancement needs is an important initial step. Data collected and analyzed to date indicate the occurrence of eutrophication-related problems, and the need to formulate approaches for the enhancement of water quality in tailwaters. The compilation of water quality management technologies and the formulation of a framework within which to develop and implement water quality management plans will insure that the CE will continue to reach its water quality goals. (See also W89-13231) (Lantz-PTT)
W89-13232

MICROCOMPUTER SOFTWARE FOR THE ANALYSIS OF WATER QUALITY SAMPLING DESIGN.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 7A.
W89-13233

USE OF REMOTE SENSING TECHNIQUES TO ENHANCE IN SITU WATER QUALITY MONITORING.
Army Engineer District, Rock Island, IL. Water Quality and Sedimentation Section.
For primary bibliographic entry see Field 7B.
W89-13234

MULTI-PORTED, SINGLE WET-WELL INTAKE STRUCTURE OPERATION IN A STRATIFIED RESERVOIR.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
S. E. Howington.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 32-38, 3 fig, 3 ref.

Descriptors: *Model studies, *Water quality control, *Mathematical equations, *Reservoir operation, Algorithms, Reservoirs, Mixing, Mathematical studies, Intakes.

Withdrawal from a density stratified reservoir can often be made from a limited vertical range. This practice, known as selective withdrawal, is made possible by the limited movement imposed by the density stratification and may permit release of a controllable quality of water. Operation of a single port using selective withdrawal is often adequate to meet a release water quality objective. However, due to resource limitations, it is frequently necessary to withdraw from multiple ports at different elevations and mix the different water qualities to achieve the desired result. Single wet-well structures are increasing in popularity for several reasons. Among these are potential economic savings over dual wet-well structure construction and the impracticality of establishing individual flow control on each potential level of simultaneous withdrawal. A multi-port, single-flow-control blending algorithm has been developed that has tested well in all cases thus far. These cases include a variety of sizes and shapes of single wet-well intake structures. All of the evaluations made to date have been in a quantitative fashion with good agreement between predictions and observations. The algorithm has been incorporated into two one-dimensional, mathematical reservoir models that employ the selective withdrawal technology. This has provided a means of operating is type of reservoir intake structure in a more predictable and controllable manner. (See also W89-13231) (Lantz-PTT)
W89-13235

REAERATION AT LOW-HEAD STRUCTURES: PRELIMINARY RESULTS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
S. C. Wilhelms.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 39-47, 3 fig, 13 ref.

Descriptors: *Aeration, *Dissolved oxygen, *Hydraulic structures, *Low flow, *Water quality control, Weirs, Spillways, Gates, Flow discharge.

Reaeration or dissolved oxygen (DO) uptake at hydraulic structures can be a major source of water quality maintenance or improvement in inland waters. Consequently, it is very important to understand the reaeration characteristics of the various types of hydraulic structures. Past reaeration work has focused on relatively high head projects. There is a particular shortfall in understanding the gas transfer characteristics of low-head projects. As a part of the ongoing Water Quality Research Program (WQRP) and with support from several field offices, a research effort was launched to fill part of the information void around low-head projects. To improve release DO, two operational recommendations can be made based on the field observations: (1) overflow weir discharge should be maximized relative to discharge through the low-sill spillway, and/or (2) the unit (single-gate) discharge should be maximized. However, for any of these operations, hydraulic feasibility must be considered. Limits may occur in the effectiveness of these operational alternatives as discharge becomes very large. The single-dose tracer gas technique is an applicable technology, but with the limitation relative to structure flow characteristics. The dilution factor of flow through the structure must be < 10 degrees. There are plans to develop a description for dilution factor as a function of structure geometry and flow conditions. Additional field testing and data analysis are planned to further the understanding of reaeration through gate structures as well as overflow weirs. (See also W89-13231) (Lantz-PTT)
W89-13236

MODELING WATER QUALITY IMPACTS OF HYDROPOWER RETROFITTING ON LOCKS AND DAMS OF THE LOWER OHIO RIVER.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W89-13237

DISSOLVED OXYGEN STUDIES BELOW WATER F. GEORGE DAM.
Army Engineer District, Mobile, AL.
D. I. Findley, and K. Day.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 52-60, 4 fig, 2 ref.

Descriptors: *Reservoirs, *Dissolved oxygen, *Water quality control, *Dam effects, *Environmental effects, Walter F George Dam, Hydroelectric plants, Spillways, Tailwater, Monitoring, Water resources development, Water resources development.

The Walter F. George (WFG) Lake is formed along the Chattahoochee River by the WFG Lock and Dam (L and D), which is located near Fort Gaines, Georgia. Approximately 47 river km downstream of WFG L and D is the George W. Andrews (GWA) L and D. Problems with fishkills in the WFG tailrace area during periods of stratification followed completion of these projects. Investigations into dissolved oxygen (DO) problems at WFG were conducted in two phases. Phase I was conducted from 13-19 August 1986 to describe the effects of operational procedures such as generation startup sequences, spillway releases and lock discharges on DO and temperature in the immediate tailrace and at locations farther downstream. Phase II, conducted from 9-10 September 1987, focused on identifying the source of the low DO water observed in the tailrace during the Phase I study. Data from Phase I indicated that compressed starting of the generators, ie., all units sequentially within minutes of one another, minimizes the acuteness and the duration of the DO drop. Data collected during spillway gate openings indicated that comparatively, there is no difference between releases from gate 14 modified with stoplogs and other gates. When DO levels were severely depressed, the spillway releases resulted in more dramatic improvements compared to releases when tailwater DO was 3.0 mg/L or better. Intensive monitoring in the tailrace area substantiated the hypothesis that extremely low DO water moved into the downstream area from the turbine discharge bays. A comparative analysis of data collected for both days of the Phase II test failed to show a correlation between DO readings when the tailgates were lowered and those measured when the gates were raised. This suggests that the passageways controlled by the tailgates are not the conduits by which low DO water reaches the tailrace. DO readings measured the second night of the study declined to concentrations that were lower than those observed during the first night, or those observed in the lake. A deterioration in lake conditions or discharges from underground wells, which are common in the vicinity, may account for the lower DO readings the second night. (See also W89-13231) (Lantz-PTT)
W89-13238

COORDINATING THE WATER QUALITY ACT OF 1987.
Army Engineer District, Nashville, TN.
For primary bibliographic entry see Field 6E.
W89-13239

LAKE CHICOT: THE FINAL CHAPTER.
Army Engineer District, Vicksburg, MS.
D. R. Johnson.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 67-76, 9 fig, 1 tab, 6 ref.

Descriptors: *Lake restoration, *Sediment control, *Water quality control, *Lake Chicot, *Water quality, Suspended solids, Chemical analysis, Macon Lake, Turbidity, Nitrates, Chlorophyll a, Phosphates, Phosphorus, Suspended sediments, Sediment load.

Lake Chicot is the largest natural lake in Arkansas. Fishing in this lake has declined steadily since completion of the Mississippi River mainline levees in 1920. The Lake Chicot Project was completed in 1985, and was designed to reduce the heavy suspended sediment loads to the lake by diverting

inflows > 400 cu ft/sec to the Mississippi River. Prior to project completion, the lake was plagued with high suspended solid levels for 6 to 8 months of the year (annual mean=350 mg/L). Coupled with the high sediment load was high nutrient loading. Eight water quality parameters were selected to evaluate the effectiveness of the project. They were turbidity, secchi depth, total solids, suspended solids, nitrate, chlorophyll a, orthophosphorus, and total phosphorus. Concentrations of these parameters at Macon Lake, Upper and Lower Lake Chicot (Stations 3, 4, and 7) were plotted, and illustrate that for most of these parameters the post-project changes are clear and marked. Measured levels in the lower lake of both solids, turbidity, total phosphorus and nitrate dropped sharply in early 1985, while the levels at the other two stations were more constant. Chlorophyll a and secchi depth values increase at Station 7 and remained relatively constant at the other two stations. The changes in orthophosphorus were less clear, but the baseline levels decreased at station 7 in early 1985. Lower Lake Chicot and Ditch Bayou displayed significant temporal differences for all eight parameters tested. Thus, the Lake Chicot Project has been successful in improving the water quality in Lake Chicot. (See also W89-13231) (Lantz-PTT)
W89-13240

CUMBERLAND BASIN WATER QUALITY MODEL.
Army Engineer District, Nashville, TN.
For primary bibliographic entry see Field 6G.
W89-13241

WATER QUALITY EVALUATION OF PROPOSED OUTLETS FROM DEVILS LAKE NEAR DEVILS LAKE, ND.
Army Engineer District, St. Paul, MN.
For primary bibliographic entry see Field 4A.
W89-13242

THERMAL STRATIFICATION IN MILL CREEK RESERVOIR.
Corps of Engineers, Walla Walla, WA. Environmental Resources Branch.
For primary bibliographic entry see Field 2H.
W89-13243

UNDER-ICE HYDRODYNAMICS AT TIOGA LAKE, PA.
Corps of Engineers, Baltimore, MD. Water Control Management Section.
For primary bibliographic entry see Field 2H.
W89-13246

TOWN BROOK RELIEF TUNNEL DESIGNING FOR ANOXIA AND H2S GENERATION.
Corps of Engineers, Waltham, MA. New England Div.
T. G. Barker.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 153-160, 3 fig, 11 ref.

Descriptors: *Wastewater treatment, *Urban runoff, *Water pollution treatment, *Storm sewers, *Aeration, *Water quality control, *Relief sewers, *Hydrogen sulfide, Town River Bay, Dissolved oxygen, Storm runoff, Diffusion.

The Town Brook Relief Tunnel is a 12-ft diameter inverted siphon 4,060 ft long which carries excess flow from urban areas of Quincy, MA, into tidal reaches of Town River Bay. When urban runoff meets saltwater in a closed container 160-ft below ground, the result will be rapid dissolved oxygen (DO) depletion and the generation of hydrogen sulfide (H2S) gas; an additional effect of 160-ft of hydrostatic head will allow the H2S to build to supersaturated levels. When a storm flushes the tunnel's anaerobic, supersaturated H2S waters into Town River Bay, the results would be unacceptable at best. In order to prevent such occurrences, water quality maintainance scheme has been proposed. The source of the anticipated water quality problems in the tunnel is somewhat complex, and includes organic matter and debris from storm events. Using a Streeter-Phelps method, a worst case (99th % biochemical oxygen demand (BOD) load) tunnel discharge was routed through the Town River and into Town River Bay. The results indicated that an anaerobic plume could persist for 3 hrs and another 2 hrs could be required to restore conditions to the levels required by State standards--a 6 mg/L DO. This was considered unacceptable. The primary goal of the water quality maintenance plan is to prevent H2S; the secondary goal is to prevent low DO or anaerobic discharge. There are a number of ways this could be accomplished. These fall into three general categories; flushing the tunnel, pumping the tunnel dry between runoff events, or mechanically aerating the tunnel. Studies indicated that only tunnel aeration was a viable means of preventing the potential adverse effects of tunnel discharges. The proposed aeration method uses an air compressor to pump air into the outlet shaft through a coarse-bubble diffuser. The rising bubbles will cause the aerated water to rise to the surface so that gaseous exchange can occur with the atmosphere and prevent dissolved gas supersaturation. A pump will move the aerated outlet water at a rate of 1,000 gallons per minute through 6-in. diameter pipes to the tunnel inlet shaft to get circulation throughout the tunnel. This system will circulate the tunnel's contents every 2.6 days. (See also W89-13231) (Lantz-PTT)
W89-13247

APPLICATIONS OF MIXERS AND AERATORS FOR RESERVOIR IMPROVEMENT.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. E. Price, and J. P. Holland.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 161-169, 11 ref.

Descriptors: *Lake restoration, *Destratification, *Mixing, *Water quality control, *Aeration, *Reservoirs, Thermal stratification, Dissolved oxygen, Hypolimnion, Stratification.

Most Corps of Engineers (CE) reservoirs undergo some degree of thermal stratification on an annual basis. This stratification, which is a result of insolation, usually begins in the late spring of each year. This stratification pattern, although set up by meteorological conditions, is naturally controlled by the corresponding density of the water. CE reservoirs designed for hydropower and/or flood control are often equipped with low-level releases. Even if the center-line elevation of these releases is located near the elevation of the thermocline, the withdrawal zone will typically extend well into the hypolimnion. Therefore, releases from these projects during the stratified periods may be low in dissolved oxygen (DO) and contain excessive levels of iron, manganese and hydrogen sulfide. In-reservoir alternatives that utilize artificial methods of destratification and aeration are discussed. There are two major categories of artificial circulation (destratification) devices: (1) mechanical mixers that usually produce a hydraulic jet; and (2) air diffuser systems that use air bubbles released near the bottom to induce mixing. Hypolimnetic aeration systems are variations of either mechanical or air-diffuser systems that only affect the hypolimnion, thereby preserving the general stratification pattern. A direct-drive surface mixer was used successfully at J. Percy Priest Lake, TN, in a localized mixing application to increase the DO in the release. (See also W89-13231) (Lantz-PTT)
W89-13248

DEVELOPING AN OPERATIONAL WATER TEMPERATURE MODEL FOR THE COLUMBIA RIVER SYSTEM.
Army Engineer Div. North Pacific, Portland, OR. Water Quality Section.
For primary bibliographic entry see Field 6G.
W89-13249

DESTRATIFICATION OF BEECH FORK LAKE.
Corps of Engineers, Huntington, WV. Huntington District.
For primary bibliographic entry see Field 2H.
W89-13250

GROUND WATER MANAGEMENT PLAN FOR THE CONSTRUCTION OF THE BONNEVILLE NAVIGATION LOCK.
Army Engineer District, Portland, OR.
J. D. Graham, D. Scofield, S. Farooqui, S. Sagstad, and K. Foster.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 203-214, 4 fig, 6 ref.

Descriptors: *Water quality control, *Groundwater quality, *Locks, *Water resources development, *Columbia River, *Fish hatcheries, Wells, Bonneville Dam, Groundwater management, Aquifers.

The new navigation lock at Bonneville Dam on the Columbia River is being built because the present lock is obsolete; it is unable to handle the present and projected barge sizes and volume of shipping. The location of the new lock and approach channel will necessitate the removal of the present Bonneville Fish Hatchery (BFH) well field and installation of a new well field. In addition, lock construction will also require extensive dewatering of the same Pre-Slide Alluvium aquifer (PSA) that is used to supply water to the BFH. To reconcile the potential problems of the two major well fields and the limited sustained yield potential of the PSA, the Portland District Geology Section and groundwater consultants have developed a groundwater management plan for the construction of the navigation lock. The purpose of the plan is to ensure the continued supply of high quality groundwater to the fish hatchery while achieving construction dewatering for the navigation lock. Conceptual aspects and activities planned to further quantify and implement the plan are briefly discussed. (See also W89-13231) (Author's abstract)
W89-13252

RELATIONSHIP BETWEEN SUBSURFACE GEOHYDROLOGIC INVESTIGATION AND SITING OF UPLAND DISPOSAL SITES/ DEWATERING SITES FOR USE OF DREDGED MATERIAL AS SANITARY LANDFILL COVER.
Army Engineer District, New York.
For primary bibliographic entry see Field 5E.
W89-13260

TIERED APPROACH FOR EVALUATING SEDIMENT QUALITY AT MULTIPLE COASTAL AND RIVERINE DREDGING PROJECTS.
Army Engineer District, Portland, OR. Advance Planning Branch.
For primary bibliographic entry see Field 7A.
W89-13264

PROCEEDINGS: CONFERENCE ON POINT-OF-USE TREATMENT OF DRINKING WATER.
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
For primary bibliographic entry see Field 5F.
W89-13269

POINT-OF-ENTRY AND POINT-OF-USE DEVICES FOR MEETING DRINKING WATER STANDARDS.
Environmental Protection Agency, Washington, DC.
S. W. Clark.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 4-9, 2 ref.

Descriptors: *Water quality standards, *Drinking water, *Water treatment, Water quality management, Potable water, Monitoring, Technology.

After considering all public comments and through a variety of discussions at all levels of management, EPA decided that point-of-entry (POE) de-

vices were suitable for compliance of drinking water standards, but they were not best available technology (BAT). It was also decided that point-of-use (POU) and bottled water could be used as interim measures, but were not to be considered BAT or a means of compliance. The EPA promulgated a rule in July 1987 that allowed POE devices as a means of compliance with the final maximum contamination levels (MCLs) for volatile organic chemicals. POU or bottled water could only be used to alleviate unreasonable risks to health during a variance or exemption period. It is hoped that this rule will allow for a more accessible means of compliance, and would, in turn, increase their compliance rate. The rule specifies criteria and procedures that attempt to assure quality and safety when POE is applied for compliance purposes. The five criteria necessary for compliance using POE are: central control, effective monitoring, application of effective technology, maintenance of microbial safety, and protection of all consumers. The goal of these five criteria is to assure that when POE devices are applied by public water systems for compliance with drinking water standards, the water is as safe as the time-tested methods of central water treatment. These criteria provide for adequate public health protection, while at the same time allowing for an innovative, decentralized approach (ie., POE). This approach will allow a cost effective means of compliance for small systems that have had the most violations of EPA's drinking water standards. The criteria developed by EPA will be adopted and implemented by the states with the goal of providing safe drinking water to all communities. (See also W89-13269) (Lantz-PTT)
W89-13270

REGULATORY REQUIREMENTS FOR POINT-OF-USE SYSTEMS.
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
For primary bibliographic entry see Field 5F.
W89-13271

CONTROL OF POINT-OF-USE WATER TREATMENT DEVICES IN CANADA: LEGAL AND PRACTICAL CONSIDERATIONS.
Environmental Health Directorate, Ottawa (Ontario).
R. S. Tobin.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 12-14, 9 ref.

Descriptors: *Water treatment, *Regulations, *Legal aspects, *Canada, Legislation, Standards, Filters.

Point-of-use devices are becoming common household appliances in Canada, as they are in the U.S. In Canada, there is no specific legislation controlling the sale, use, or performance of point-of-use (POU) water treatment devices. A number of acts, however, do have provisions that could be related to these devices, including: (1) the Pest Control Products Act, administered by Agriculture Canada, regulates products that are intended to control any kind of pest; (2) the Medical Devices Regulations, of the Food and Drugs Act are used to control devices that are 'manufactured, sold or represented for use in the prevention of diseases; (3) the Hazardous Products Act, administered by Consumer and Corporate Affairs Canada authorizes the Minister to carry out investigations and demand information regarding consumer products, to determine whether such products are likely to be a danger to the health or safety of the public; and (4) the Competition Act, which supersedes the Combined Investigation Act. Although these legislative tools are used for more serious problems, the department policy has been to avert problems before they occur. Therefore, the Canadian program on POU devices includes the following aspects: testing and evaluation of devices; provision of advice and educational materials; and cooperation with industry and nonprofit organizations. (See also W89-13269) (Lantz-PTT)
W89-13272

REGULATION OF WATER TREATMENT DEVICES IN CALIFORNIA.
R. F. Burns.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 15-17, 4 ref.

Descriptors: *California, *Water treatment, *Regulations, *Legislation, Public policy, Drinking water.

During 1986, the California legislature introduced two legislative measures regarding point-of-use (POU) and point-of-entry (POE) water treatment devices. One measure, addressed the performance of POU/POE water treatment devices for which a claim relative to the health or safety of drinking water is made. The other measure addressed advertising claims made in the sale of POU/POE water treatment devices. Both bills were passed by the legislature, signed by the Governor, and became effective on January 1, 19877. The provisions of these Senate Bills are described in this paper. The California Department of Health Services (DHS) Public Water Supply Branch (PWSB) has been given the responsibility for the implementation of the first Senate Bill, and is currently developing policy and regulations for the implementation of a certification program. (See also W89-13269) (Lantz-PTT)
W89-13273

WISCONSIN REGULATION OF POINT-OF-USE AND POINT-OF-ENTRY WATER TREATMENT DEVICES.
Wisconsin Dept. of Industry, Labor and Human Relations, Madison.
L. Trapp.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 18-21, 3 append.

Descriptors: *Water quality standards, *Water treatment, *Regulations, *Wisconsin, Drinking water, Standards, Water quality control, Potable water, Public policy.

Wisconsin's involvement in regulating point-of-use (POU) and point-of-entry (POE) water treatment devices involves five different state agencies. Two of those state agencies, the Department of Justice (DOJ) and the Department of Agriculture, Trade and Consumer Protection (DATCP), have consumer protection sections. A third state agency, the Department of Health and Social Services (DH and SS), is responsible for recommending enforcement standards for the groundwater contaminants of public health concern. The enforcement standard may be the actual maximum contaminant level (MCL) set by the US EPA or may be below the MCL if scientific evidence for the lower number is presently available but was not considered when the MCL was established. The Department of Natural Resources (DNR), the fourth state agency, uses the enforcement standards to establish whether or not a water supply is contaminated. After a public hearing process, the DNR usually adopts the recommended enforcement standard into its regulations. The fifth state agency is the Department of Industry, Labor and Human Regulations (DILHR), which reviews all POU and POE water treatment devices for the following: rendering inactive or removing aesthetic and health related contaminants; suitability of construction materials for use with potable water; ability of the device to withstand the pressures to which it will be subjected; and proper installation instructions. (See also W89-13269) (Lantz-PTT)
W89-13274

HOUSEHOLD WATER QUALITY EDUCATION: THE COOPERATIVE EXTENSION SYSTEM ROLE.
Kansas State Univ., Manhattan. Cooperative Extension Service.
For primary bibliographic entry see Field 5F.
W89-13275

FEDERAL TRADE COMMISSION REGULATION OF WATER TREATMENT DEVICES.
Federal Trade Commission, Washington, DC.
J. Winston.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 25-26.

Descriptors: *Water treatment, *Regulations, *Federal Trade Commission, Advertising, Publications, Legal aspects.

The Federal Trade Commission (FTC) is a small independent Federal agency established in 1914. The FTC's mission includes the regulation of anti-competitive practices such as price fixing and monopolization, as well as regulation of false advertising. The FTC does not have the resources to pursue every potentially deceptive practice, and no specific regulations governing the advertising of water treatment devices. Like other advertising, claims for these devices must be truthful and substantiated. In recent months the FTC has brought two formal actions against advertisers of water treatment devices. In the summer of 1987, one organization was charged with false advertising of its home water distiller, and in August 1987, the FTC issued an administrative complaint against another corporation regarding a table-top activated carbon filter device. In general, the types of advertising claims that the FTC may be concerned about in this area are: claims that a device will purify the water or remove all contaminants. These claims should be supported by reliable evidence and appropriately qualified; claims that ordinary tap water is hazardous to health. These claims should be carefully substantiated and qualified; and false claims of consumer or expert endorsements. Consumer testimonials should be representative or qualified clearly. (See also W89-13269) (Lantz-PTT)
W89-13276

POU/POE PRODUCT PROMOTION GUIDELINES AND CODE OF ETHICS.
Water Quality Association, Lisle, IL.
M. M. Robb.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 27-30, 2 fig.

Descriptors: *Standards, *Water quality control, Regulations, Public participation, Public policy, Governmental interrelations, Organizations.

The promulgation of the Voluntary Industry Product Promotion Guidelines (VIPPG) and the creation of the Water Quality Industry Review Panel was prompted by concerns expressed to the Water Quality Association (WQA) by various agencies of the Federal governments of the United States and Canada, state and provincial enforcement agencies, and members of the water quality improvement industry. The guidelines are not intended to provide all or any part of the wording of anyone's specific promotional material. They are merely designed to provide a general framework within which more accurate and informative advertising, promotional, and sales presentation material can be prepared in such a way as to avoid misleading consumers about the capabilities of water quality improvement products. Two types of requests can be submitted through the VIPPG process. They are a Complaint Request, filed on an existing advertisement or promotion which can be voluntarily resolved or can move on the Review Panel; and an Advisory Request, in which a company submits its promotional material or advertising for compliance prior to printing or releasing it. The review panel members hear complaints that fulfill the following criteria: name, address, and telephone number of source material; written and dated entries; copy of all materials to be reviewed; details--how, when, where the material was used; particular guidelines possibly violated; explicit request for opinion; explicit request for opinion; full legal name, address, and telephone number of submitting party; and, the requesting party agrees to not misrepresent and to limit reference to opinion or results. Voluntary compliance is requested by all involved parties. (See also W89-13269) (Lantz-PTT)
W89-13277

POINT-OF-USE AND POINT-OF-ENTRY TREATMENT DEVICES USED AT SUPERFUND SITES TO REMEDIATE CONTAMINATED DRINKING WATER.
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5F.
W89-13293

EFFECTS OF AGRICULTURAL WATER TABLE MANAGEMENT ON DRAINAGE WATER QUALITY.
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs, R. O. Evans, and J. W. Gilliam.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-204416/AS. Price codes: A06 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Completion Report No. 237, (UNC-WRRI-89-237), March 1989. 87p, 60 fig, 7 tab, 24 ref, append. Project WRRI 70056/70081.

Descriptors: *Water quality control, *Control drainage, *Drainage, *North Carolina, *Nutrient transport, Subsurface drainage, Nutrients, Phosphorus, Nitrogen, Water table, Agricultural water.

The primary objective of this study was to determine the magnitude of the water quality benefits provided by controlled drainage practices used to manage water tables at different sites and under different soil conditions. Five sites, originally established by the Soil Conservation Service to demonstrate to farmers the water-conserving potential of water table management, were selected for this study to encompass a wide range of soil and site properties representative of the poorly drained soils of the Tidewater region of North Carolina. Drainage control was accomplished by placing flash-board riser type control structures in the drainage outlets. Drainage control was very effective in reducing drainage outflow and the potential transport of nutrients to receiving surface waters. The control structures reduced drainage outflow by approximately 40% as compared to conventional drainage practices. The dominant factor influencing total nutrient transport was the amount of drainage outflow which was reduced by controlled drainage practices. The reduction in nutrient transport was nearly proportional to the reduction in drainage outflow. Controlled drainage reduced the annual transport of the total nitrogen (NO3 and TKN) by 7 kg/ha and total phosphorus by 0.19 kg/ha. Considering that nearly 1 million hectares of cropland in North Carolina are artificially drained, this represents a potential reduction at the field's edge of nearly 7,000 metric tons of nitrogen and 190 metric tons of phosphorus annually. (Lambert-UNC-WRRI)
W89-13320

SIMULATION OF CHANGES IN STORMWATER QUALITY AT FOUR POTENTIAL FLOW-ATTENUATION SITES IN THE IRONDEQUOIT CREEK WATERSHED, MONROE COUNTY, NEW YORK.
Geological Survey, Albany, NY. Water Resources Div.
P. J. Zarriello, and J. M. Surface.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $8.75, microfiche $4.00. USGS Water-Resources Investigations Report 88-4106, 1989. 52p, 13 fig, 14 tab, 58 ref.

Descriptors: *Model studies, *New York, *Storm runoff, *Sedimentation basins, *Urban hydrology, *Water pollution control, Model studies, Nonpoint pollution sources, Settling basins.

The potential for improving stormwater quality in the Irondequoit Creek watershed, New York, using flow attenuation basins was analyzed by deterministic simulations of sediment retention. Simulations are based on 'plug-flow' concepts and settling of particulate matter according to Stoke's law in (1) temporary storage basins, which retain storm runoff but allow normal runoff to pass unimpeded, and (2) maximum storage basins, which maintain a permanent pool of water. The rate of suspended-sediment retention varies with particle size and detention time. The detention time is a function of basin size, rate of inflow, and type of basin simulated and is greater in maximum storage basins, which produce an 8 to 84% greater suspended-sediment load reduction than temporary storage basins. The predicted annual suspended-sediment-load retention ranges from 28 to 32% in temporary storage basins and from 33 to 60% in maximum storage basins. Total annual loads of phosphorous, lead, and zinc, constitutents that are often absorbed to sediment particles, would be reduced by 22 to 59%, 20 to 47% and 16 to 38%, respectively, according to suspended-sediment simulations. Actual sediment-retention and chemical-retention rates may be less than predicted, however, because (1) the sediment may be resuspended mechanically, (2) anaerobic conditions may cause release of adsorbed constitutents into the dissolved phase, and (3) metals may become remobilized in the presence of high concentrations of chlorides from road salts. (USGS)
W89-13332

EVALUATION OF METHODOLOGY FOR DELINEATION OF PROTECTION ZONES AROUND PUBLIC-SUPPLY WELLS IN WEST-CENTRAL FLORIDA.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-13350

POTENTIAL FOR HYDRILLA DISPERSAL BY SEXUAL MEANS IN NORTH CAROLINA SURFACE WATERS.
North Carolina State Univ. at Raleigh. Dept. of Crop Science.
For primary bibliographic entry see Field 4A.
W89-13354

BINDING OF XENOBIOTICS TO HUMIC MATERIAL IN THE AQUATIC ENVIRONMENT.
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
J. M. Bollag.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-193379/AS. Price codes: A04 in paper copy, A01 in microfiche. Pennsylvania Environmental Resources Research Institute, University Park, Final Report ER8903, February 1989. 61p, 21 fig, 5 tab, 67 ref. Contract 14-08-0001-G1137.

Descriptors: *Detoxification, *Enzymes, *Humic acids, *Phenolic pesticides, Hydrobiology, Pesticides, Pesticide toxicity, Phenols, Industrial wastes, Oxidoreductases, Hydrolases, Laccase, Water pollution control, Binding, Chlorophenols, Wastewater treatment, Oligomers, Separation techniques, Xenobiotics.

The research evaluates using immobilized enzymes, oxidoreductases and hydrolases to remove or detoxify phenolic and pesticidal compounds from the aquatic environment. Particularly, the research focuses on the binding of zenobiotics to humic substances through the activity of oxidoreductive enzymes. Experiments with bound chlorophenols showed that release, especially microbial release, from humic material was limited and small amounts were mineralized by microorganisms. Experiments showed that immobilized enzyme can be used for detoxifying various pollutants by enzyme-catalyzed polymerization or binding of phenolic and other xenobiotic compounds to humic substances. A number of oxidoreductases and hydrolases were covalently linked to various types of soils and clays using 3-aminopropyltriethoxysilate (APTES) and glutaraldehyde as 'coupling agents'. Most enzymic activity was recovered for a phenoloxidase, namely a laccase. Incubation of this laccase with 2,4-dichlorophenol caused oligomers to form which are insoluble in aqueous solution and thus can be removed. The coupling of 2,4-dichlorophenol to fulvic and humic acid could also be determined in the presence of other oxidoreductases such as tyrosinase, peroxidase and a laccase of Rhizoctonia praticola. (USGS)
W89-13360

LAND-USE POLICY AND THE PROTECTION OF GEORGIA'S ENVIRONMENT.
Georgia Univ., Athens. Carl Vinson Inst. of Government.
For primary bibliographic entry see Field 6E.
W89-13390

HAZARDOUS WASTE MANAGEMENT FACILITY SITING IN GEORGIA.
Georgia Univ., Athens. Carl Vinson Inst. of Government.
For primary bibliographic entry see Field 5E.
W89-13394

DEVELOPMENT OF A COMBINED QUANTITY AND QUALITY MODEL FOR OPTIMAL MANAGEMENT OF UNSTEADY GROUNDWATER FLOW FIELDS.
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
R. C. Peralta, J. Solaimanian, and C. L. Griffis.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-214373/AS. Price codes: A04 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Publication No. 134, June 1988. 43p, 10 fig, 10 ref. USGS Project G-1409-04.

Descriptors: *Groundwater management, *Optimization, *Solute transport, *Computer models, *Unsteady flow, Groundwater quality, Water quality management, Model studies, Simulation analysis, Advection, Dispersion.

Alternative techniques are presented for incorporating conservative solute transport equations into computer models designed for optimizing groundwater extraction rates. The equations assume unsteady two-dimensional flow, and dispersed conservative solute transport. Implicit and explicit finite difference equations for solute transport are compared for practicality. After calibration, the equations are used in a MODCON procedure, an integrated series of five optimization or simulation modules. Results of the calculations are compared with those resulting from a model based upon the method of characteristics. The procedure is applicable for an entire aquifer system, or for a subject. (Peralta-AR U., WRRC)
W89-13400

GROUNDWATER RESOURCES ASSESSMENT OF THE PIEDMONT REGION IN SOUTH CAROLINA.
Clemson Univ., SC. Dept. of Agricultural Engineering.
R. K. White, A. W. Badr, and A. D. Christy.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-217558/AS. Price codes: A04 in paper copy, A01 in microfiche. South Carolina Water Resources Research Institute, Clemson Publication No. 129, May 1988. 59p, 16 fig, 7 tab, 18 ref. USGS Contract 14-08-0001-G1448. USGS Project G1448-02.

Descriptors: *Groundwater, *Piedmont Region, *Databases, *South Carolina, Water supply management, Water quality management, Planning, Well yield, Geohydrology, Data collections.

This report summarizes the available groundwater databases found in the South Carolina District of the United States Geological Survey (USGS), the South Carolina Department of Health and Environmental Control (DHEC), and the South Carolina Water Resources Commission (WRC). Only part of the data on groundwater in the South Carolina Piedmont is computerized. Well data formats are not uniform between agencies or between divisions within agencies. A preliminary statistical analysis of the WRC database indicated that the single variable most closely correlated with well yield was well diameter. On average will yield showed a slight increase with depth down to about 350 ft and then decreased with greater depths. The primary conclusion is the need for a common or compatible computerized groundwater database. Verification and completion of existing data should also be a priority. Analysis of regional water yield

relationships and development of a hydrogeological unit map would enhance the ability of groundwater personnel to locate higher yielding wells and to make more efficient use of the region's groundwater resources. (White-SC WRRI)
W89-13407

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

BAROON POCKET DAM (AUSTRALIA) RECREATION STRATEGY: AN APPROACH TO A PLAN.
Knight (Sinclair) and Partners Pty Ltd., Spring Hill (Australia).
For primary bibliographic entry see Field 5F.
W89-12217

EVALUATION OF THE RECREATIONAL BENEFITS OF MAJOR DAMS IN QUEENSLAND, AUSTRALIA.
Queensland Water Resources Commission, Brisbane (Australia).
For primary bibliographic entry see Field 6D.
W89-12235

COMPUTERIZING THE PLANNING, ANALYSIS AND MAINTENANCE OF WATER SYSTEMS.
Psomas and Associates, Santa Monica, CA.
B. Murillo.
Public Works PUWOAH, Vol. 120, No. 5, p 86-88, May 1989.

Descriptors: *Automation, *Planning, *Maintenance, *Water management, Computers, Computer programs, Pipelines, Data acquisition, Land use, Pumps, Pipes, Water tanks, Valves, Hydrants.

A unique computer program that successfully combines a sophisticated geographical information system (GIS) with a pipe network analysis model has recently been developed by Psomas and Associates to provide a flexible and valuable tool for engineers charged with planning, analyzing, and maintaining water systems. This new program provides a user-friendly method for planning new water facilities, analyzing changes in a system from land development (or abandonment of facilities), and establishing a successful maintenance operation. In addition, the one-time capturing of needed data, verification of data, modifying or updating, ease of analysis, and both hardcopy reporting and graphic presentations, are provided for the user. The ability to capture data easily, use it in many different ways, and analyze potentially complex changes provides a very valuable tool for water system operation. Water purveyors will always be asked to supply new communities and areas of growth with water facilities. As these systems continue to grow, the impact of the growth and the maintenance of the existing facilities become a difficult task. This program allows the quick analysis of growth impacts and aids in new and ongoing maintenance responsibilities. Operation of water systems can be enhanced with the use and continued improvement of the GIS and pipe analysis combination. (Author's abstract)
W89-12398

SOLVING PROBLEMS OF MICRO HYDRO DEVELOPMENT IN NEPAL.
Schweizerische Kontaktstelle Angepasste Technik, Sankt Gallen.
For primary bibliographic entry see Field 8C.
W89-12407

RISK ANALYSIS FOR DAM DESIGN IN KARST.
For primary bibliographic entry see Field 8A.
W89-12628

COEFFICIENT OF POLLUTION: PALOS VERDES CALIFORNIA SHELF 1973 AND 1984.
California State Univ., Long Beach. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W89-12645

OPTIMIZATION STUDY OF THE PLANNING OF WATER POLLUTION CONTROL FOR MAJIAGOU STREAM IN HARBIN, CHINA.
Harbin Architectural and Civil Engineering Inst. (China). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5E.
W89-13075

REALISING THE VALUE OF RESEARCH.
North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 9C.
W89-13079

RAINFALL INTERVENTION ANALYSIS FOR ON-LINE APPLICATIONS.
Texas A and M Univ., College Station. Dept. of Industrial Engineering.
For primary bibliographic entry see Field 6D.
W89-13122

WATER RIGHTS MODELING AND ANALYSIS.
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6E.
W89-13123

WATER RESOURCES MANAGEMENT IN ARID CLIMATES.
Milliken Chapman Research Group, Inc., Littleton, CO.
J. G. Milliken.
Desalination DSLNAH, Vol. 72, No. 1/2, p 173-184, Apr./May 1989. 3 fig, 10 ref.

Descriptors: *Cost analysis, *Water resources development, *Metropolitan water management, *Urban planning, *Arid-zone hydrology, Water supply, Economic evaluation, Social aspects, Environmental policy, Water demand, Hydrologic budget, Community development.

A methodology has been developed for planning and managing water supplies for metropolitan areas in arid climates where water resources are severely limited. This methodology is intended to lead to a thorough analysis (involving economic, social, and environmental considerations) of known alternative means of increasing water supplies or of reducing water demand, and to help select a least-cost mix of actions that will achieve a supply/demand balance for water throughout the selected planning period. The technique of cost-effectiveness analysis is recommended to help determine the optimum mix of strategies that will achieve the desired goal of matching water supply and demand at the least cost. 'Cost' is used in a broad sense that involves a weighing, not only of economic costs, but also of social and environmental considerations. Because social, cultural, and environmental considerations differ from one area to another, the best solution for one metropolitan area will not necessarily be best for another. Therefore, this methodology must be considered within the framework of overall community goals, i.e., the desires of the citizens with respect to growth, environment, and quality of life as well as adequate water supply. (Author's abstract)
W89-13148

CALIFORNIA SITE MITIGATION DECISION TREE PROCESS: SOLVING THE 'HOW CLEAN SHOULD CLEAN BE' DILEMMA.
California Dept. of Health Services, Sacramento.
For primary bibliographic entry see Field 5E.
W89-13202

ESTIMATING HEALTH RISKS AT HAZARDOUS WASTE SITES: DECISIONS AND CHOICES DESPITE UNCERTAINTY.
ENVIRON Corp., Washington, DC.
For primary bibliographic entry see Field 5G.
W89-13207

WATER QUALITY MANAGEMENT FOR RESERVOIRS AND TAILWATERS: A WOTS DEMONSTRATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5G.
W89-13232

DREDGED-MATERIAL DISPOSAL PLANNING PROGRAMS.
For primary bibliographic entry see Field 5E.
W89-13259

MANAGEMENT OF DREDGED MATERIAL DISPOSAL AREAS.
Army Engineer District, Charleston, SC.
For primary bibliographic entry see Field 5E.
W89-13268

MONITORING AND MAINTENANCE PROGRAMS FOR POU/POE.
National Sanitation Foundation, Ann Arbor, MI.
For primary bibliographic entry see Field 5F.
W89-13292

USE OF MULTIVARIATE MODELING TO ESTIMATE IMPACTS OF GROUNDWATER WITHDRAWALS ON STREAMFLOW FOR THE CAMAS CREEK BASIN.
Idaho Univ., Moscow. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W89-13316

6B. Evaluation Process

INCOMPATIBLE RECREATION-ORIENTED BENEFITS IN A RESIDENTIAL TIDAL CANAL ESTATE AND MARINA, VICTORIA (AUSTRALIA).
Deakin Univ., Melbourne (Australia). Div. of Biological and Sciences.
P. M. Nuttall, and B. J. Richardson.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 273-279, 1989. 1 tab, 9 ref.

Descriptors: *Tidewater, *Estuaries, *Canals, *Marinas, *Recreation, *Environmental impact, Australia, Residential development.

Wide ranging recreation-oriented benefits identified from a 2-year study on a residential tidal canal estate and associated marinas were rationalized into six groups consisting of active user, passive user, commercial user, ecological benefits, antagonistic and synergistic. The nature of conflict between activities was investigated in terms of their environmental impact and management. Pathways showing the degree of conflict illustrate the incompatibilities of many recreation-oriented benefits associated with these types of coastal developments. (Author's abstract)
W89-12242

BENEFITS AND COSTS OF IMPROVING PUMPING EFFICIENCY.
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 3F.
W89-12425

REGIONAL APPROACH TO SLUDGE MANAGEMENT.
Dufresne-Henry, Inc., North Springfield, VT.
For primary bibliographic entry see Field 5E.
W89-12733

ACID RAIN GAMES: INCENTIVES TO EXAGGERATE CONTROL COSTS AND ECONOMIC DISRUPTION.

Wyoming Univ., Laramie. Dept. of Economics.
B. A. Foster.
Journal of Environmental Management JEVMAW, Vol. 28, No. 4, p 349-360, June 1989. 41 ref.

Descriptors: *Water quality, *Acid rain, *Economic aspects, *Costs, *Political aspects, Planning.

Lack of developments in acid rain control in the United States are approached by considering Hartle's intersection of games: (1) the special interest group game, (2) the political game, and (3) the bureaucratic game. The special interests groups--electric utilities, coal companies, coal miners and electricity consumers in the mid-west and east--have an incentive to emphasize scientific uncertainty of benefits of control while exaggerating the costs of control and economic disruption that would result in order to avoid, or at least delay, any legislation that would reduce their economic welfare. It is shown, using estimates from various sources, that the cost and disruption is not as firm as the opponents claim. The views of the politicians are consistent with the special interests of the regions they represent, but each couch their opposition in the more altruistic sounding argument that benefits are uncertain while costs are high and known. The scientists and bureaucrats may also be caught in a bureaucratic game in which research activity is scored to justify policy positions rather than improve knowledge. It is concluded, using an insurance analogy, that the various uncertainties provide a reason for acid rain control action rather than inaction in order to avoid potential irreversibilities associated with acid rain impacts. (Author's abstract)
W89-12763

PLANNING GROUND WATER MONITORING FIELD PROJECTS.
SCS Engineers, Inc., Long Beach, CA.
For primary bibliographic entry see Field 7A.
W89-12873

DIFFUSION APPROXIMATION FOR EQUILIBRIUM DISTRIBUTION OF RESERVOIR STORAGE.
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 8A.
W89-12990

SCHEMES OF IMPROVING THE SANITARY AND ENGINEERING STATE AND USE OF MULTIPURPOSE RESERVOIRS.
For primary bibliographic entry see Field 5G.
W89-13108

WATER CONSERVATION IN ARID AND SEMI-ARID REGIONS.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Islamic and Arabic Studies.
A. A. Akkad.
Desalination DSLNAH, Vol. 72, No. 1/2, p 185-205, Apr/May 1989. 2 fig, 8 tab, 24 ref, append.

Descriptors: *Arid lands, *Semiarid lands, *Water demand, *Water resources development, *Metropolitan water management, *Public participation, *Water conservation, Planning, Water allocation, Water use efficiency, Economic aspects, Social aspects, Environmental policy, Communication, Public relations, Public policy, Persian Gulf.

Water demand in various sectors in the Arabian Gulf Countries is increasing to an alarming level. Measures to control the demand have become an increasingly important issue to water resources planners and decision makers. Physical methods of demand suppression, economic incentives, integrated water resources planning, and implementation of sociological parameters are various ways to conserve water resources. The use of these methods must be studied in conjunction with the public participation. Any new conservation plan must be compatible with current plans, cultural aspects, organizational structure, and public desires. A survey must be performed to determine the general public attitude towards the technological, economic, social benefits, and environmental aspects of the various water conservation measures, and should be updated every five years. Conducting a survey on water conservation issues should be preceded by intensive audio-visual and written campaigns through various media such as television shows, announcement, public talks, speeches, and school programs. This will help to develop a positive response prior to measuring the attitude of people towards the different policies and issues to be studied in the survey. (Fish-PTT)
W89-13149

MOBILE HARBOR, ALABAMA, DUMP SCOW OVERFLOW TEST: PRELIMINARY REPORT OF FINDINGS.
Corps of Engineers, Mobile, AL. Coastal Environment Section.
For primary bibliographic entry see Field 5E.
W89-13267

EFFICIENT AND EQUITABLE SOLUTION OF INDIAN RESERVED RIGHTS.
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 6E.
W89-13398

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

STUDY OF RECREATIONAL USE OF SYDNEY WATER BOARD AND FISH RIVER WATER SUPPLY STORAGES (AUSTRALIA).
Longworth and McKenzie Consultants Pty Ltd., Crows Nest (Australia).
For primary bibliographic entry see Field 5F.
W89-12219

ECONOMIC INCENTIVES FOR IRRIGATION DRAINAGE REDUCTION.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3F.
W89-12423

MARKET ANALYSIS FOR MULTI-COMPOST PRODUCTS.
Cal Recovery Systems, Inc., Richmond, CA.
For primary bibliographic entry see Field 5E.
W89-12494

ASSESSING THE VALUE OF HYDROGEOLOGIC INFORMATION FOR RISK-BASED REMEDIAL ACTION DECISIONS.
Harvard School of Public Health, Boston, MA. Program in Environmental Health and Public Policy.
For primary bibliographic entry see Field 5G.
W89-12972

LEAST-COST DESIGN OF AQUEDUCT SYSTEMS.
Iowa Univ., Iowa City. Inst. for Economic Research.
For primary bibliographic entry see Field 5F.
W89-13128

MODIFIED SYSTEM OF SUBSIDIZING DISTILLED WATER IN KUWAIT.
College of Technological Studies, Shuwaikh (Kuwait).
For primary bibliographic entry see Field 3F.
W89-13153

6D. Water Demand

RECREATIONAL USE OF THE CATCHMENTS AND STORAGES OF SYDNEY WATER BOARD (AUSTRALIA).
Sydney Water Board (Australia). Headworks Branch.
For primary bibliographic entry see Field 5F.
W89-12221

EVALUATION OF THE RECREATIONAL BENEFITS OF MAJOR DAMS IN QUEENSLAND, AUSTRALIA.
Queensland Water Resources Commission, Brisbane (Australia).
G. L. Fahey.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 229-235, 1989. 6 fig, 8 tab, 1 ref.

Descriptors: *Dams, *Recreation, *Economic aspects, Operating costs, Maintenance costs, Planning, Clawson method, Australia.

The 'Final Clawson Demand Curve' method was used to evaluate the recreational benefits of four major dams in Queensland, Australia. The use of existing demand curves to predict the demand for recreational facilities at proposed sites was also investigated. The results indicate that the demand curves are sensitive to changes in variables such as travel costs. However, within the method is the potential to provide estimates of the recreational worth of proposed dams. (Author's abstract)
W89-12235

RECREATIONAL USE CONSIDERATIONS OF THE SUGARLOAF RESERVOIR (MELBOURNE, AUSTRALIA).
Melbourne and Metropolitan Board of Works (Australia). Investigation and Research Branch.
N. H. Howard.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 251-254, 1989. 4 ref.

Descriptors: *Storage reservoirs,*Reservoirs, *Catchment areas, *Recreation, *Public health, *Water management, Economic aspects, Sugarloaf River, Australia.

Sugarloaf Reservoir, one of Melbourne's newer storages, draws an increasing proportion of its water from the unprotected and polluted lower Yarra requiring all supply to be comprehensively treated before being supplied to consumers. Because of this special situation, compared to harvesting from protected catchments, a recreational use study of the reservoir and its small natural catchment was initiated. A Phase 1 study, from the public health point of view, recommended that the present nominal recreational use (passive) at Sugarloaf Reservoir could be extended to include shore-based fishing, establishment of a catchment nature trail, sailing, rowing, youth club and model yacht sailing. A Phase 2 study reported on the financial and management aspects, while a Phase 3 study considered an implementation plan to be submitted to the Board and Minister for Water Resources for consideration for the summer of 1988. (Author's abstract)
W89-12238

SOME FURTHER EVIDENCE ON THE DERIVED DEMAND FOR IRRIGATION ELECTRICITY: A DUAL COST FUNCTION APPROACH.
Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economics.
J. D. Connor, D. Glyer, and R. M. Adams.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1461-1468, July 1989. 4 tab, 40 ref.

Descriptors: *Irrigation water, *Water use, *Irrigation practices, *Energy costs, *Irrigation efficiency, Agricultural water.

Most crop production in the Western United States is dependent on water from irrigation, often using substantial amounts of energy to obtain and apply such water. The sensitivity of crop production to rising energy costs is an issue of concern to producers, input suppliers, and others. The effects of increasing electricity prices on electricity consumption and other production inputs are assessed using a dual cost estimation procedure. The empiri-

cal focus is on selected regions of the western United States, where electricity is the primary source of irrigation energy. Demand for irrigation electricity varies across regions but is found to be price elastic. Increases in electricity prices are likely to lead to retirement of less energy-efficient sprinklers and to decreases in irrigated acreage, especially in the Columbia River Basin. (Author's abstract)
W89-12973

RAINFALL INTERVENTION ANALYSIS FOR ON-LINE APPLICATIONS.
Texas A and M Univ., College Station. Dept. of Industrial Engineering.
T. Sastri, and J. B. Valdes.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 4, p 397-415, July 1989. 5 fig, 3 tab, 19 ref. NSF Grant ECE-8504772.

Descriptors: *Model studies, *Texas, *Water demand, *Rainfall, *Hydrologic models, Time series analysis, Algorithms, Mathematical studies, Rainfall intervention model, Management planning.

Rainfalls in summer are a major cause of sporadic nonlinear transient drops in daily municipal water consumption. The nonhomogenous, nonlinear effects induced by rainfall interventions on water use complicate time series model identification and estimation. An iterative computer algorithm employing a model-switching transfer function is proposed for sequential estimation of the transient drops in water consumption so that they can be removed from the time-series data. Existing time series analysis techniques, which are based on homogeneous, covariance stationary assumptions, are not directly applicable because the water-use time series never reaches statistical equilibrium. The practical data transformation procedure introduced here is useful for achieving approximately homogeneous and stationary time series prior to model identification and estimation of rainfall intervention effects. The resulting empirical model is a transfer function of intervention time, number of uninterrupted raining days, a moving average of maximum daily temperatures, and a moving average of the most recent water-use observations. This rainfall intervention model also can be sued for on-line prediction of temporal changes in daily water consumption of a city, given rainfall forecasts. The applicability of this approach is illustrated using the example of a record of municipal water use for Austin, Texas. (Author's abstract)
W89-13122

WATER RESOURCES OF GCC: INTERNATIONAL ASPECTS.
For primary bibliographic entry see Field 6E.
W89-13129

INVESTIGATIONS OF GROUNDWATER RESOURCES IN CENTRAL JORDAN.
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
For primary bibliographic entry see Field 2F.
W89-13147

WATER CONSERVATION IN ARID AND SEMI-ARID REGIONS.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Islamic and Arabic Studies.
For primary bibliographic entry see Field 6B.
W89-13149

ESTIMATION, ANALYSIS, SOURCES, AND VERIFICATION OF CONSUMPTIVE WATER-USE DATA IN THE GREAT LAKES-ST. LAWRENCE RIVER BASIN.
Geological Survey, Albany, NY. Water Resources Div.
D. S. Snavely.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $5.00, microfiche $4.00. USGS Water-Resources Investigations Report 88-4146, 1988. 28p, 3 fig, 4 tab, 38 ref.

Descriptors: *Water use, *Water demand, *Great Lakes, *Consumptive use, Water law, Great Lakes Region, St Lawrence River, Water utilization, Diversion.

The Great Lakes-St. Lawrence River basin provides water for many uses and for wildlife habitat; thus many groups have developed strategies to manage the basin's water resource. The International Joint Commission (IJC) is reviewing and comparing available consumptive-use data to assess the magnitude and effect of consumptive uses under present projected economic and hydraulic conditions on lake levels. As a part of this effort, the U.S. Geological Survey compared its own estimates of consumptive use in the United States with those generated by (1) the International Great Lakes Diversions and (2) the IJC. The U.S. Geological Survey also developed two methods of calculating consumptive-use projections for 1980 through 2000; one method yields an estimate of 6,490 cu ft/s for the year 2000; the other yields an estimate of 8,330 cu ft/s. These two projections could be considered the upper and lower limits for the year 2000. The reasons for the varying estimates are differences in (1) methods by which base year values were developed, and (2) the methods or models that were used to project consumptive-use values for the future. Acquisition of consumptive-use data from water users or governmental agencies or ministries would be desirable to minimize reliance on estimates. (USGS)
W89-13331

6E. Water Law and Institutions

SETTING AND ACHIEVING WATER QUALITY CRITERIA FOR RECREATION.
Gutteridge, Haskins and Davey, Melbourne (Australia).
For primary bibliographic entry see Field 5G.
W89-12212

MANAGEMENT OF RECREATIONAL WATER QUALITY IN ESTUARIES AND COASTAL WATERS: AN INTEGRATED STUDY.
Water Research Centre, Medmenham (England). Medmenham Lab.
For primary bibliographic entry see Field 5G.
W89-12214

CLOSE CALL AT SEA: DELAWARE'S COASTAL ZONE ACT WEATHERS A CONSTITUTIONAL CHALLENGE.
Delaware Univ., Newark. Coll. of Urban Affairs and Public Policy.
A. D. Zimmerman.
Coastal Management CZMJBF, Vol. 17, No. 1, p 1-23, 1989. 1 fig.

Descriptors: *Judicial decisions, *Delaware, *Coastal zone management, *Constitutional law, Policy making, Federal jurisdiction, State jurisdiction, Coal, Transportation.

Delaware's Coastal Zone Act, in effect since 1971, has survived a recent constitutional challenge under the dormant Commerce Clause, brought by the Norfolk Southern Corporation. Norfolk Southern had sought to establish a coal transfer operation in the Delaware Bay, an activity that was found to be prohibited under the Coastal Zone Act. The Delaware law, which is incorporated into an approved coastal management program, prohibits new heavy industry and bulk product transfer facilities within the coastal zone. Whereas the U.S. Department of Commerce had approved the state's program, it chose to join Norfolk Southern as a 'friend of the court.' In the final decision, the law was upheld. However, the basis on which the decision was made raises some disturbing questions about the future of this and similar state coastal regulatory statutes. A synopsis of the history of the case is presented, followed by an in-depth examination of the issues surrounding dormant Commerce Clause review, using the Norfolk Southern example as a springboard. It is shown that this area of constitutional analysis poses some potential problems of vulnerability and uncertainty for state coastal regulations in the context of national coastal zone management under the Coastal Zone Management Act of 1972 as amended. The paper concludes with an assessment of the implications of this and other court decisions for state efforts to regulate coastal land and water uses, given the points of potential vulnerability. (Author's abstract)
W89-12495

COASTAL ZONE DEVELOPMENT, UTILIZATION, LEGISLATION, AND MANAGEMENT IN CHINA.
China Inst. for Marine Development Strategy, Beijing.
For primary bibliographic entry see Field 4D.
W89-12497

IN SEARCH OF A STRATEGY FOR COASTAL ZONE MANAGEMENT IN THE THIRD WORLD: NOTES FROM ECUADOR.
Private Agencies Collaborating Together, San Jose (Costa Rica).
K. Merschrod.
Coastal Management CZMJBF, Vol. 17, No. 1, p 63-74, 1989. 5 ref.

Descriptors: *Management planning, *Developing countries, *Coastal zone management, *Planning, Ecuador, Public participation, Interagency cooperation, Legal aspects.

The strategy developed for the University of Rhode Island Coastal Resource Management Project in Ecuador is described. This strategy relies on 'working groups' and differs from traditional coastal zone management planning strategies prevalent in 'First World' countries because of its flexibility and informality--factors that facilitate maximum participation of interested agencies and constituencies while avoiding institutional rigidity. (Author's abstract)
W89-12498

WHAT A LAYPERSON NEEDS TO KNOW ABOUT WATER RIGHTS.
D. J. Finlayson.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 457-462, June 1989.

Descriptors: *Water permits, *Water rights, *Water law, *Legal aspects, Reviews, Riparian waters, Permits, State jurisdiction, Water use, Groundwater, Navigation, Fisheries.

Background information is provided to make the process of obtaining a water right more understandable. Water rights in the United States are reviewed, and showed a large variation among states. Also, water rights laws and regulations are changing: a broader view of beneficial use of water, but a stricter view of reasonable use, are being taken. The right to use water is governed by treaties, court decisions, various state and federal laws and regulations, as well as local regulations. A few states operate under a system that recognized a combination of riparian, appropriative, and permitted rights. In some states, the permit process is applied to groundwater. In some western states, recent court rulings have required that states consider how water policies affect public trust values such as navigation, commerce, and fisheries. The process for filing an application for water rights is reviewed. (Friedmann-PTT)
W89-12638

SCIENTIFIC ANALYSIS OF PROPOSED SLUDGE RULE.
Agricultural Research Service, Beltsville, MD.
For primary bibliographic entry see Field 5E.
W89-12768

ASSESSMENT AND MANAGEMENT OF SURFACE WATER QUALITY IN ENGLAND AND WALES.
Water Research Centre, Medmenham (England).
For primary bibliographic entry see Field 5G.
W89-12912

WELSH RIVERS AND RESERVOIRS: MANAGEMENT FOR WILDLIFE CONSERVATION.
University Coll., Cardiff (Wales). School of Pure and Applied Biology.
For primary bibliographic entry see Field 5G.
W89-12921

SCIENTIST, RESEARCHERS, AND ACID RAIN.
Colorado State Univ., Fort Collins. Dept. of Political Science.
L. R. Alm.
Journal of Environmental Systems JEVSBH, Vol 18, No. 3, p 265-278, 1988-1989. 19 ref.

Descriptors: *Institutional constraints, *Water pollution effects, *Water pollution sources, *Acid rain, *Air pollution, Rainfall, Precipitation, Research scientists, Political aspects, Governmental interrelations, Water policy.

The role of the hidden participants in agenda-setting for environmental issues is discussed. These personnel involve academics, researchers, career bureaucrats, congressional staffers, consultants, and administration appointees below the top level. Scientists have been publicly involved in the acid rain issue from the beginning, using the media to dramatize the possible catastrophic consequences of acid rain. Svante Oden presented a series of lectures in 1971 that served as a catalyst for further research and publication in this field. Presently, the scientific community is not in consensus about the solutions to the problem. Indeed, public debate among the researchers has caused much confusion among policy makers and resulted in the dilemma of delaying action and risking environmental damage or acting prematurely and wasting millions of dollars in a deficient program. Since the initial enactment of the National Acid Precipitation Act in 1980, not a single acid rain law has been passed, although many bills have been proposed (37 bills in the 97th and 98th congresses, for example). Spokesman for the coal and utility industries and Reagan administration personnel have used the scientific disagreements to delay abatement actions and refute claims that acid rain is a severe problem. Another result of the confusion is a distrust and even disdain for academic work. One possible solution to the stalemate, as proposed by Roy Gould, is an accurate forum for resolving scientific disputes that have a strong political component and that the forum should have a mechanism for converging on accurate science. (Cassar-PTT)
W89-12948

ENVIRONMENTAL CRISIS IN INDIA: A CASE STUDY OF PUNJAB.
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Landschaftsoekonomie.
For primary bibliographic entry see Field 5B.
W89-13008

WATER PRIVATISATION AND THE ENVIRONMENT.
Salford Univ. (England). Environmental Resources Unit.
For primary bibliographic entry see Field 5F.
W89-13009

EVALUATION OF NORTH CAROLINA'S ESTUARINE SHORELINE AREA OF ENVIRONMENTAL CONCERN FROM A WATER QUALITY PERSPECTIVE.
East Carolina Univ., Greenville, NC. Dept. of Geography and Planning.
For primary bibliographic entry see Field 5G.
W89-13047

RIVER QUALITY MODELS FOR CONSENT SETTING IN ENGLAND AND WALES.
WRC Engineering, Swindon (England).
For primary bibliographic entry see Field 5B.
W89-13077

WATER RIGHTS MODELING AND ANALYSIS.
Texas A and M Univ., College Station. Dept. of Civil Engineering.
R. A. Wurbs, and W. B. Walls.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 4, p 416-430, July 1989. 1 fig, 4 tab, 13 ref.

Descriptors: *Model studies, *Water rights, *Texas, *Mathematical models, *Water supply, Available water, Brazos River Basin, TAMUWRAP System, Reservoirs, Water yield, Case studies, Management planning, Utilities.

A generalized model for simulation of surface water management under a prior appropriation water rights system was developed recently and applied to the Brazos River Basin, a major river basin in Texas. The water rights analysis model provides capabilities for evaluating institutional and hydrologic water availability. The case study provides a perspective on key considerations in water rights modeling and analysis. A river basin should be viewed as an integrated system. Water available to a particular water management entity depends on the impacts of other water users in the basin. Increases in reservoir yield achieved by system operations should be reflected properly in water rights. Assigning priorities by appropriation date versus type of use and assigning priorities to refilling storage capacity are two other issues that illustrate the complexities of administering and modeling water rights. The TAMUWRAP system provides a broad range of water rights modeling and analysis capabilities. The generalized model can be used to evaluate the quantity of water that can be supplied by a reservoir system, considering the impacts of other senior water rights in the basin. (Author's abstract)
W89-13123

WATER RESOURCES OF GCC: INTERNATIONAL ASPECTS.
R. L. de Jong.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 4, p 503-510, July 1989. 1 fig, 9 ref.

Descriptors: *Arabian Peninsula, *International agreements, *Water resources, *Water resources development, Gulf Cooperation Council, Interbasin transfers, Aquifers, Kuwait, Saudi Arabia, United Arab Emirates, Oman, Bahrain, Yemen, Iraq, Qatar, Shared resources.

Rapid economic development in the member states of the Gulf Cooperation Council (GCC) has led to major hydrologic stresses being laid on the aquifers underlying most of the Arabian Peninsula. These aquifers presently constitute the major local resource and, to a significant degree, they are shared across international boundaries. Several cases exist in which water issues have an international dimension. Countries involved in these cases are Kuwait and Saudi Arabia, United Arab Emirates and Oman, Bahrain and Saudi Arabia, Saudi Arabia and Oman, Kuwait and Iraq, Saudi Arabia and Qatar, and Yemen and Saudi Arabia. In addition, some water issues relate to all the Persian Gulf states. The 'Basic Law' of the GCC provides necessary and sufficient rules for the creation of an international framework to manage these shared groundwater resources. (Rochester-PTT)
W89-13129

WATER RESOURCE INSTITUTIONS AND POLICIES IN ARID REGIONS.
Banks (Harvey O.) Consulting Engineer, Inc., Belmont, CA.
H. Banks.
Desalination DSLNAH, Vol. 72, No. 1/2, p 217-224, Apr/May 1989. 1 fig.

Descriptors: *Water resources institutes, *Arid lands, *Water resources development, *Water management, *Water policy, *Interagency cooperation, *Environmental policy, Governmental interrelations, Interbasin transfers, Institutions, Economic aspects, Public relations, Population dynamics, Legal aspects, Planning, Social aspects, California.

The state of California, with its rapidly growing population and limited water resources, is in the nation's forefront in management of its water resources. A comprehensive set of institutions and policies, and comprehensive statewide interbasin water transfer systems have been developed since the mid-1800s. The institutions and policies are changing rapidly resulting from changes in the economy, in public needs, perceptions and attitudes, and from population growth. Major changes have resulted from court decisions in recent years. Changes have been embodied in statutes enacted by the Congress and the state legislature. A very important enactment was passage of the National Environmental Policy Act of 1969. This resulted in major changes in planning for the development and management of water resources, emphasizing protection and enhancement of environmental values, and protection of cultural and social values. (Author's abstract)
W89-13151

ENVIRONMENTAL POLICIES AT THE NATIONAL AND REGIONAL LEVELS: THE ROLE OF EPC, GCC AND ROPME.
Ministry of Public Health, Safat (Kuwait). Environment Protection Dept.
M. Y. Abdulraheem.
Desalination DSLNAH, Vol. 72, No. 1/2, p 225-233, Apr/May 1989. 1 fig, 4 tab, 11 ref.

Descriptors: *Regional development, *Administrative agencies, *International commissions, *Water resources development, *Water management, *Arid-zone hydrology, *Environmental policy, *Water demand, *Interagency cooperation, Water quantity, Water supply, Domestic water, Industrial water, Agricultural hydrology, Artificial recharge, Artificial precipitation, Desalination, Evaporation control, Wastewater, Planning, Kuwait.

The constantly increasing demand for a sufficient quantity and quality of water requires a comprehensive, complex, and elastic strategy for water resource management. In the arid zone of the Arabian Gulf Region, the demand for water can be categorized as domestic and trade, industrial, and agricultural. Resources available to meet this demand are freshwater, brackish water, treated effluent, and seawater. Striking the balance between the production and demands may require developing new resources (artificial rain, desalination, groundwater mining) or decreasing consumption (evaporation suppression, reduction in household consumption, minimizing distribution system leakage, restricting freshwater use for irrigation and/or industrial cooling systems, recycling treated wastewater). Storage of excess water during low-demand seasons could also be practiced by aquifer recharge. The environmental policy of Kuwait is created by several governmental agencies who interrelate to address the environmental implications of water resources management and development. The Kuwaiti Environment Protection Council addresses water and the environmental implications of water resources management and development. The Gulf Cooperation Council (GCC) of Kuwait, Saudi Arabia, Oman, Qatar, Bahrain, and the United Arab Emirates has recently formulated directives concerning groundwater resources. As for the Regional Organization for the Protection of the Marine Environment which encompasses the GCC countries in addition to Iraq and Iran, interest in water resources management stems from concern over deterioration of seawater quality, the possible impact on marine life and stability of coastal habitats through release of pollutants and upsetting of the hydrologic cycle due to landfilling of coastal areas. These water resources planners must take into account multiple users, multiple purposes, and multiple objectives. They must understand the probable irreversibility of the impact of large projects on natural ecosys-

tems and on social and economic programs. (Fish-PTT)
W89-13152

HOW CLEAN IS CLEAN: THE NEED FOR ACTION.
General Electric Co., Fairfield, CT.
For primary bibliographic entry see Field 5G.
W89-13203

HOW CLEAN IS CLEAN: AN ENVIRONMENTALIST PERSPECTIVE.
Environmental Defense Fund, Washington, DC.
For primary bibliographic entry see Field 5G.
W89-13204

GROUND WATER CONTAMINATION ISSUES IN SANTA CLARA COUNTY, CALIFORNIA: A PERSPECTIVE.
Santa Clara Valley Water District, San Jose, CA.
For primary bibliographic entry see Field 5G.
W89-13205

COORDINATING THE WATER QUALITY ACT OF 1987.
Army Engineer District, Nashville, TN.
H. T. Sansing.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 61-66.

Descriptors: *Tennessee, *Water Quality Act, *Water quality control, *Water pollution sources, Water quality management, Nonpoint pollution sources, Land disposal, Urban runoff, Forestry, Agriculture, Legislation, Agricultural runoff, Governmental interrelations.

In December 1987, the EPA issued two guidance documents for states to follow in implementing Section 314, the Clean Lakes Program (CLP), and Section 319, the Nonpoint Source (NPS) Pollution Program, of the Water Quality Act (WQA) of 1987. The State of Tennessee completed a preliminary draft assessment under Section 319 guidelines in September 1987, which has identified seven major pollutant categories of nonpoint source pollution: agriculture; resource extraction; forestry; urban runoff; hydrologic modification; land disposal; and other, including waste storage/storage tank leaks, spills, in-place contaminants, marinas, natural source, barge discharges, and application of aquatic herbicides/pesticides. Section 319 requires the state's assessment be completed by April 1988 and the nonpoint source management program by August 1988. There are three sections of information to be included in the management program. These are: to define existing conditions regarding the degree of water pollution associated with nonpoint sources; to define best management practices to diminish pollution by source category; and to define interagency programs with specific responsibility for reducing or quantifying nonpoint source pollution. (See also W89-13231) (Lantz-PTT)
W89-13239

POU/POE PRODUCT PROMOTION GUIDELINES AND CODE OF ETHICS.
Water Quality Association, Lisle, IL.
For primary bibliographic entry see Field 5G.
W89-13277

WATER QUALITY ASSOCIATION VOLUNTARY PRODUCT VALIDATION PROGRAM AND VOLUNTARY CERTIFICATION PROGRAM.
Water Quality Association, Lisle, IL.
L. Cole.
IN: Proceedings: Conference on Point-of-Use Treatment of Drinking Water. Report No. EPA/9-88/012, June 1988. p 35-36.

Descriptors: *Water quality control, *Education, *Water quality standards, Regulations, Water treatment, Organizations.

One of the basic purposes of the Water Quality Association (WQA) is to promote the acceptance and use of point-of-use/point-of-entry industry equipment, products, and services. One of the most successful programs to promote this concept was the development of voluntarily industry standards. The WQA developed five voluntary industry standards: S-100-85 for household commercial and portable exchange water softeners; S-101-80 for efficiency-rated water softeners; S-200-73 for household and commercial water filters; S-300-84 for point-of-use low pressure reverse osmosis drinking water systems; and S-400-86 for distillation drinking water systems. Under this program, a manufacturer may voluntarily submit a specific type of equipment or system to the WQA laboratory where its performance will be carefully evaluated in accordance with the appropriate standard. When a system has successfully performed to the specific testing protocol, it is then qualified to receive the appropriate 'gold seal.' This seal alerts the consumer that the equipment he/she is considering purchasing complies with the specifications of a very rigorous testing program. The WQA initiated a certification program which was established by association members to provide industry-wide standards for evaluating the knowledge of point-of-use/point-of-entry water treatment personnel and to improve the knowledge of those who service the consumer, thereby encouraging professionalism and integrity in the industry. Since the inception of WQA's certification program in 1977, nearly 1,800 people have been certified in one of three categories: dealer, specialist, or installer. The WQA developed a comprehensive training program divided into 12 sessions. Each lesson consists of a pre-lesson questionnaire to evaluate one's knowledge about the subject, exercises to help evaluate one's knowledge while preparing a lesson, and finally, questionnaires that are completed and mailed to the WQA headquarters for correction. The corrected questionnaires are then returned to the student for his review. (See also W89-13269) (Lantz-PTT)
W89-13279

ESTIMATION, ANALYSIS, SOURCES, AND VERIFICATION OF CONSUMPTIVE WATER-USE DATA IN THE GREAT LAKES-ST. LAWRENCE RIVER BASIN.
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-13331

LAND-USE POLICY AND THE PROTECTION OF GEORGIA'S ENVIRONMENT.
Georgia Univ., Athens. Carl Vinson Inst. of Government.
J. E. Kundell, R. W. Campbell, J. M. Heikoff, L. R. Hepburn, and R. Klant.
Carl Vinson Institute of Government, University of Georgia, Athens, 1989. 160p, 12 fig, 12 tab, 104 ref.

Descriptors: *Environmental policy, *Environmental protection, *Water law, *Land use, *Georgia, *Urban planning, Environmental quality, Nonpoint pollution sources, Planning, Watersheds.

Georgia's growth and development are the results of many factors, not the least of which are the natural resource base and the quality environment that the state has to offer. In Georgia, environmental protection has become principally the responsibility of federal and state environmental agencies while land-use programs are primarily the responsibility of local governments. The problem with this division is that in Georgia only a local government can evaluate the total environmental impact of a proposed activity, and then, only if that local government has implemented a well-conceived planning and land-use control program. To make effective land-use policy, local officials must relate their decisions to the natural resources and overall environment of their jurisdictions. This book considers existing land-use policies and practices in Georgia, discusses the problems associated with current approaches, and offers recommendations for improving the land-use decision-making processes to produce decisions that are more environmentally sensitive. (Allen-U.GA-Inst. Gov.)
W89-13390

GEORGIA WETLANDS: TRENDS AND POLICY OPTIONS.
Georgia Univ., Athens. Carl Vinson Inst. of Government.
J. E. Kundell, and S. W. Woolf.
Carl Vinson Institute of Government, University of Georgia, Athens, 1986. 112p, 10 fig, 11 tab, 34 ref, append.

Descriptors: *Aquaculture, *Environmental policy, *Georgia, *Environmental protection, *Water management, *Water resources development, *Wetlands, Water rights, Water policy, Wildlife, Tidal marshes.

Georgia has an extensive belt of coastal saltwater marshlands that separates the coastal barrier islands from the mainland. Awareness of the value of these marshes has resulted in legislation providing for orderly development in coastal Georgia to avoid altering these sensitive environments. Inland freshwater wetlands are much more extensive and variable than coastal marshes, but less attention has been paid to these areas. In recent years, evidence has accumulated indicating a wide range of beneficial functions performed by freshwater wetlands and the types of problems that may result from their alteration. This, in turn, has stimulated consideration of legislation and other mechanisms to ensure that freshwater wetlands are not needlessly converted to other uses. A number of studies have been conducted in the state and nationally to quantify wetland acreage. This publication brings together in one book the current case law regulating wetlands, discussion of the administrative management programs that exist in Georgia and other states, and consideration of what options are available for accomplishing wetlands management objectives in Georgia. (Allen-U.GA-Inst. Gov.)
W89-13391

MANAGEMENT OF GEORGIA'S MARSHLANDS UNDER THE COASTAL MARSHLANDS PROTECTION ACT OF 1970.
Georgia Univ., Athens. Carl Vinson Inst. of Government.
J. E. Kundell, J. Kealey, R. Klant, and L. Wilson.
Report, 1988. 34p, 1 fig, 9 tab.

Descriptors: *Georgia, *Wetlands, *Marshes, *Environmental protection, Tidal marshes, Marsh management, Environmental policy.

In 1970, the Coastal Marshlands Protection Act was passed by the Georgia General Assembly to establish a review procedure for those activities that could cause the conversion of coastal marshes. Since its passage, the law has not been substantively amended. The Coastal Resources Subcommittee of the House Natural Resources Committee proposed that a study be conducted by the Carl Vinson Institute of Government at the University of Georgia to ascertain the effectiveness of the Coastal Marshlands Protection Act and to determine if amendments to the Act were necessary. This report presents the findings of the Institute's study. (Allen-U.GA-Inst. Gov.)
W89-13392

INTERBASIN AND INTRABASIN WATER TRANSFER IN GEORGIA.
Georgia Univ., Athens. Carl Vinson Inst. of Government.
J. E. Kundell, D. Roper, and M. Kelm.
Report, January 1987. 95p, 2 fig, 9 ref, 2 append.

Descriptors: *Water transfer, *Interbasin transfers, *Water rights, *Georgia, Transboundary water transfers, Water allocation, Riparian doctrine.

To protect vested interests in water resources, the legislative and judicial systems in various jurisdictions have developed mechanisms to foster or impede movement of water from one river basin to another. The location of Atlanta in the Piedmont of Georgia has fostered development of interbasin and intrabasin water transfers. Under traditional riparian law, use of water on non-riparian lands, and thus in a different river basin, was not legally allowed. However, development of case law to

recognize the reasonable use of water on nonriparian lands and the passage of the 1977 amendments to the Water Quality Control act enable interbasin water transfer to occur legally. To meet the growing need for a more systematic process to address interbasin transfer permit applications, the Georgia Department of Natural Resources contracted with the University of Georgia's Carl Vinson Institute of Government to develop an objective approach to evaluate permit applications for interbasin transfers of water. This report focuses on the legal and administrative process addressing interbasin and intrabasin water transfers in Georgia. (Allen-U.GA-Inst. Gov.)
W89-13393

EFFICIENT AND EQUITABLE SOLUTION OF INDIAN RESERVED RIGHTS.
Arizona Water Resources Research Center, Tucson.
W. B. Lord, T. R. McGuire, and M. G. Wallace.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-214498/AS. Price codes: A03 in paper copy, A01 in microfiche. Final Report, June 1989. 22p, 1 fig, 4 tab. USGS Contract 14-08-0001-G1320.

Descriptors: *Arizona, *Water rights, *Alternative water use, Water allocation, Optimization, Comprehensive planning, Gila River basin, Model studies, Adjudication procedures, Hydrologic models, San Pedro River Basin, Economic aspects, Indian water rights, Negotiated settlements, Reserved water rights.

The water rights claims of many Indian reservations in the West are now under adjudication. Frequently, the parties to these adjudications acknowledge that their interests may be better served through negotiated settlements, but they lack comprehensive means for determining mutually acceptable solutions to the conflicts. This research sought to (1) develop a conceptual basis for determining Indian water rights; (2) develop an analytical procedure to provide the information needed to resolve water rights conflicts; and (3) apply this analytical procedure to a test case involving the Gila River Basin in Arizona. The methodological core of the research is a set of linked models, encompassing historical, hydrologic, economic, psychological, and institutional elements of the conflict. Hydrologic, institutional, and economic analyses of conjunctive management of surface and groundwater supplies were facilitated by the use of MODSIM, a network optimization model. Data from the model enabled the investigators to construct an impact matrix, defining the effect of each possible settlement option on the goals of the parties. The preferences of the parties were elicited through social judgement analysis. Twelve settlement options were defined on the basis of knowledge of other negotiated settlements, and a final option, representing possible outcomes should the negotiation process fail, was included in the analysis. The next step was to model the possible choices available to the contending parties, utilizing an n-person cooperative game framework. This analysis indicated that a set of three settlement options dominated the adjudication option for all players. Each of these included the provision of imported water in lieu of water currently being used in the basin. (USGS)
W89-13398

6G. Ecologic Impact Of Water Development

CLOSE CALL AT SEA: DELAWARE'S COASTAL ZONE ACT WEATHERS A CONSTITUTIONAL CHALLENGE.
Delaware Univ., Newark. Coll. of Urban Affairs and Public Policy.
For primary bibliographic entry see Field 6E.
W89-12495

HYDROLOGIC ALTERATION OF MOUNTAIN WATERSHEDS FROM SURFACE MINING.
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-12850

EFFECT OF A SERIES OF POWER STATIONS ON THE SEDIMENT TRANSPORT (BED LOAD AND SUSPENDED LOAD) IN A RIVER: THE CASE OF THE CENTRAL THIRD PART OF THE FRENCH LOWER RHONE (INFLUENCE D'UNE CHAINE D'AMENAGEMENTS HYDROELECTRIQUES SUR LE TRANSPORT SOLIDE EN RIVIERE: APPLICATION AU TIERS CENTRAL DU BAS-RHONE FRANCAIS).
Compagnie Nationale du Rhone, Lyon (France).
For primary bibliographic entry see Field 2J.
W89-12885

DISTRIBUTION OF SUBMERGED AQUATIC MACROPHYTE BIOMASS IN A EUTROPHIC STREAM, BADFISH CREEK. THE EFFECT OF ENVIRONMENT.
Wisconsin Univ., Madison. Dept. of Botany.
J. D. Madsen, and M. S. Adams.
Hydrobiologia HYDRB8, Vol. 171, No. 2, p 111-119, February 8, 1989. 4 fig, 4 tab, 43 ref.

Descriptors: *Ecological effects, *Environmental effects, *Streams, *Channeling, *Eutrophication, *Aquatic plants, Badfish Creek, Wisconsin, Macrophytes, Plant populations, Biomass, Elodea, Cladophora, Sago pondweed, Riparian vegetation, Vegetation, Water pollution effects, Trees, Streambeds.

The distribution of biomass of the macrophyte community in Badfish Creek was examined in three sections (A, B, C) totaling 10 km. Biomass samples were taken in a stratified-random manner, with sediment characteristics, depth, current velocity and incident light measured at each site to correlate individual biomass samples with environmental factors. Total community biomass decreased in the downstream section (C), with the biomass of Elodea canadensis decreasing abruptly below Section A. The only environmental factors which were correlated with the decrease in macrophyte community biomass, especially that of Potamogeton pectinatus, in Section C was the increase in substrate heterogeneity and sand substrates which lacked surface gravel. The change in substrate was related to channelization. Considering the stream as a whole, the biomass of the dominant species, Potamogeton pectinatus, was correlated with incident light. Other species present were Ceratophyllum demersum and Cladophora glomerata. Analysis of riparian vegetation type indicated that tree cover significantly reduced macrophyte biomass by incident light reduction. (Author's abstract)
W89-12946

ACCIDENTS DUE TO OXYGEN DEFICIENCY AND METHANE GAS BLOW-OFF IN TOKYO AREA, JAPAN.
Akita Univ. (Japan). Coll. of Mining.
For primary bibliographic entry see Field 2F.
W89-13011

ENVIRONMENTAL PROTECTION - A PERMANENT CHALLENGE (UNWELTSCHUTZ - EINE STANDIGE HERAUSFORDERUNG).
Bayer A.G., Leverkusen (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W89-13045

ENVIRO-ECONOMIC ASPECTS OF NAVIGATION CHANNEL DEVELOPMENT IN COASTAL LOUISIANA: A CASE STUDY.
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
C. E. Adams, and J. A. Berg-Andreassen.
Coastal Management CZMJBF, Vol. 17, No. 2, p 157-170, 1989. 5 fig, 2 tab, 22 ref.

Descriptors: *Environmental effects, *Salinity, *Coastal waters, *Channel improvement, *Navigation, *Louisiana, *Economic aspects, Environmental impact, Development, Model studies, Stochastic models, Economic justification.

A controversy has developed in the Vermillion Bay area of coastal Louisiana between commercial navigation interests seeking construction of a new 12-ft-deep channel across the bay and environmental groups who have questioned the environmental soundness and economic feasibility of the project. An hydrodynamic and economic model study was undertaken to answer these questions with the ultimate goal of facilitating rational and objective management of available resources. Results of the hydrodynamic model suggest: (1) that as a control of salinity variability, the presence of a 12-ft.-deep channel is less important than natural variations in freshwater supply, and (2) interannual salinity variability would be reduced by the construction of the proposed channel. The stochastic economic model yields benefit/cost ratios ranging from a high of 4.4 to a low of 2.9, implying strong economic justification for construction of the proposed channel. (Author's abstract)
W89-13049

CHANGES IN LAKE ECOSYSTEMS CONNECTED WITH THE POWER-GENERATING INDUSTRY (THE OUTLINE OF PROBLEM): THE KONIN LAKES (POLAND) AS THE STUDY SITES.
Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W89-13084

HYDROLOGIC EFFECTS OF INTENSE GROUNDWATER PUMPAGE IN EAST-CENTRAL HILLSBOROUGH COUNTY, FLORIDA, U.S.A.
Southwest Florida Water Management District, Brooksville.
T. O. Bengtsson.
Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 1, p 43-51, July-August 1989. 7 fig, 17 ref.

Descriptors: *Groundwater depletion, *Subsidence, *Groundwater recession, *Florida, *Water table, *Drawdown, Sinkholes, Flooding, Water shortage, Irrigation effects, Seasonal distribution, Agriculture, Shallow wells, Geohydrology, Numerical analysis, Model studies, Liability, Frost prevention, Simulation.

Well problems, water shortages, local flooding, and induced sinkholes have been periodic problems for residents in east-central Hillsborough County, Florida. This agricultural area has experienced dramatic short-term water-level declines in the Floridan aquifer due to seasonal groundwater withdrawals. The sudden declines in the potentiometric surface have been caused from intense irrigation pumpage, primarily for frost and freeze protection and fruit setting. Local residents with inadequately constructed wells lose their source of water when the potentiometric surface is lowered to depths where their wells do not function. Some residents have lost their water supplies for a week or more and many have suffered damage to their pumps. The drawdown of the potentiometric surface has induced sinkholes, causing property damage for some residents and concern among others. In addition, the high application rates for frost and freeze irrigation have created run-off problems resulting in local flooding. Fortunately, there has been no damage to houses from the flooding or sinkholes. A finite-difference, numerical model has been used to quantify the regional impacts to the potentiometric surface of the Floridan aquifer from estimated irrigation pumpage. The extent of the impact of a 35-hr period of estimated withdrawal was shown by the simulation model. Maximum drawdown within the quarter square mile area covered by the simulation was 40 ft. Simulations with smaller grid intervals indicated drawdowns of 55 ft. The computer model indicated minimal effects to the water table, but no pumpage or recharge simulated in the surficial aquifer. Consequently, no mounding or significant drawdowns were observed. Among the management approaches recommended for these problems are: (1) communication of better well design and construction methods to drillers and residents; (2) surface water engineering to solve

flood water problems; (3) investigation of tailwater recovery systems for large irrigated fields; and (4) further hydrogeologic investigations. (Rochester-PTT)
W89-13114

TIDAL POWER AND THE AQUATIC ENVIRONMENT (ENERGIE MAREMOTRICE ET ENVIRONNEMENT AQUATIQUE).
Museume National d'Histoire Naturelle, Dinard (France). Lab. Maritime.
C. Retiere.
Houille Blanche HOBLAB, No. 2, p 133-147, 1989. 13 fig, 3 tab, 37 ref. English summary.

Descriptors: *Tidal powerplants, *Estuaries, *Environmental effects, Aquatic animals, Aquatic plants, Rance River, Brittany, France, Sluice gates, Turbines.

In the Rance basin on the northern coast of Brittany a full-scale evaluation of the ecological impact of a tidal power scheme has been made, after 20 years of operation. The period of isolation of the estuary during the construction phase was particularly damaging for the environment. Gradually, after the scheme was put into service, an increasingly diverse flora and fauna became established. The patterns of distribution of this flora and fauna, their groupings into cenotic units, and the nature of their inter-relationships, indicate a variable degree of biological adjustment to the new environmental conditions. The design of the tidal power scheme has permitted re-colonization of the basin to take place, by allowing migratory organisms to pass via sluice gates and turbines. However, the new ecological equilibrium which has been established in the space of 10 years remains fragile and, being linked to the stability of abiotic conditions, depends to a large extent on the operating conditions of the tidal power scheme. (Author's abstract)
W89-13191

POPULATION DYNAMICS AND DISTRIBUTION OF JUVENILE VOBLA, RUTILUS RUTILUS, BREAM, ABRAMIS BRAMA, AND ZANDER, STIZOSTEDION LUCIOPERCA, IN THE NORTHERN CASPIAN.
Kaspiiskii Nauchno-Issledovatel'skii Inst. Rybnogo Khozyaistva, Astrakhan (USSR).
For primary bibliographic entry see Field 8I.
W89-13192

DOWNSTREAM IMPACTS OF A DAM ON A BEDROCK FLUVIAL SYSTEM, BRAZOS RIVER, CENTRAL TEXAS.
Baylor Univ., Waco, TX. Dept. of Geology.
P. M. Allen, R. Hobbs, and N. D. Maier.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 26, No. 2, p 165-189, 1989. 23 fig, 8 tab, 59 ref.

Descriptors: *Dam effects, *Brazos River, *Channel erosion, *Deltas, *Channel morphology, *Erosion control, Bank erosion, Sedimentation, Gravel, Flow models, Model studies, Aggradation, Bed load, Sediment transport, River systems, Tributaries.

Impoundment of the Brazos River at Lake Whitney Dam, Texas, had caused localized aggradation in the bedrock floored channel for more than 22 mi downstream. Patterns of aggradation are related to input of clastics from steep bedrock controlled, mixed-load tributaries. Surveyed tributary delta systems have shown steady growth since the dam was constructed in 1951. Five of the 21 tributary deltas affect river gradient, river planform, and channel dimensions. Thresholds of channel erosion on the Brazos RIver are related to delta planform size: armored tributary deltas with areas of more than 81,000 sq ft which occupy about 68% of the main stem width represent the threshold at which channel bank loss begins. Bank loss in these areas ranges from 5-14 ft per year. Channel hydraulics at the confluences are inferred from two-dimensional flow models. Five zones of flow were recognized in the confluence areas and appear to be related to delta planform and sediment transport. Delta growth is related to tributary drainage area and channel slope; most deltas are predicted to double their size in the next 35 years. Six management alternatives were considered for channel bank erosion control. Retention check dams on the tributaries built to retain the coarse bed load sediment are recommended. Mining trapped gravels in the tributaries for local road-base material is also advocated. (Author's abstract)
W89-13194

MODELING WATER QUALITY IMPACTS OF HYDROPOWER RETROFITTING ON LOCKS AND DAMS OF THE LOWER OHIO RIVER.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. J. Zimmerman.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 48-51, 2 ref.

Descriptors: *Model studies, *Water quality control, *Environmental effects, *Dam effects, *Hydroelectric plants, *Water resources development, *Ohio River, Flow profiles, Wastewater disposal.

The potential for add-on hydropower for locks and dams on the Ohio River is being considered by the Louisville District (ORL) as part of its Lower Ohio River Multipurpose Study (LORMS). Water quality impacts of hydropower retrofitting to locks and dams have been the focus of a modeling study consisting of four phases, the first phase of which leads to a model calibrated specifically for LORMS. This phase of the modeling study has produced a calibrated model that can account for changes in water quality brought about by add-on hydropower at any of the locks and dams located in the study reach. A confirmation of the model must be performed using flow and water quality data from another year to demonstrate that assumptions made for 1977 are equally valid for other years and conditions. Following model confirmation, conditions with hydropower will be tested by suppressing reaeration at the dams. A need exists to have a full inventory of waste discharge that may affect water quality. While the data from major sewage treatment plants were obtained, other less obvious inputs may have been overlooked. Furthermore, data defining sediment oxygen demand would provide helpful information. (See also W89-13231) (Lantz-PTT)
W89-13237

DISSOLVED OXYGEN STUDIES BELOW WATER F. GEORGE DAM.
Army Engineer District, Mobile, AL.
For primary bibliographic entry see Field 5G.
W89-13238

CUMBERLAND BASIN WATER QUALITY MODEL.
Army Engineer District, Nashville, TN.
J. K. Brown.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 77-82, 1 fig, 2 tab.

Descriptors: *Water quality control, *Water resources development, *Dam effects, *Dissolved oxygen, *Model studies, Reservoirs, Hydrologic models, Nutrients, Mathematical models, Temperature, Routing.

The efforts of the Nashville District of the Corps of Engineers to develop a system model to simulate water quality conditions in Cumberland Basin are described. The Nashville District operates ten dams within the basin. The system model involves operations at eight of these projects. Four of the projects are classified as tributary storage impoundments and the remainder as main stem navigation impoundments. The primary goal of the water quality modeling activities is to develop the capability to forecast impacts of proposed operations on downstream water quality conditions so that solutions to potential problems can be developed. The most important relationship to water quality in the basin the relationship between flow and outflow dissolved oxygen (DO). Other pertinent factors identified included inflow DO concentration, water temperature, epilimnion DO concentration in the forebay, shape of the withdrawal zone and turbine reaeration characteristics. Once relationships for these factors were established, they were combined in a series of equations, which were incorporated into a computer model named DORM (dissolved oxygen routing model). To reduce the input requirements and improve the accuracy of the predictions, a 2-D version of DORM named DORMII, was developed. DORM and DORMII are essentially empirical models which rely on bulk DO depletion computations and the assumption of slug flow. Any number of longitudinal segments can be specified; however, the model has only two vertical layers, the epilimnion and the hypolimnion. The model also performs routing computations for temperature. Because the model calculates temperature and the DO in the epilimnion, it requires less daily input data than DORM. This bulk depletion approach does not allow impacts of individual point and nonpoint source loadings to be determined. This requires a more sophisticated model with nutrient and DO budgets. The two models of this type being used on the main stem projects are CE-QUAL-W2 and BETTER. To develop the capability to evaluate and maximize benefits from the reservoir system, an optimization model study is being conducted. The compartmentalized approach should allow a great deal of flexibility in employing new programs and models, as they become available. (See also W89-13231) (Lantz-PTT)
W89-13241

WINTER WATER QUALITY IN LAKES AND STREAMS.
Cold Regions Research and Engineering Lab., Hanover, NH.
D. J. Calkins, and G. D. Ashton.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 117-124, 11 ref.

Descriptors: *Rivers, *Water quality, *Lakes, *Cold regions, Ice, Streams, Flow profiles, Groundwater, Water temperature, Model studies, Dissolved oxygen, Acid rain effects, Spawning, Snowmelt, Acidic water, Hydrogen ion concentration, Seasonal variation, Temperature.

The potential impacts, both beneficial and detrimental, of winter water releases from reservoirs on downstream wildlife or aquatic habitats have not been addressed in many studies. One of the biggest obstacles to assessing these impacts is the lack of basic data (water temperature, dissolved oxygen content (DO), water chemistry parameters, ice conditions, etc.). The winter season is defined as the period during which an ice cover forms on river or lake surfaces. The formation of an ice cover on a river cuts off the exchange of oxygen from the atmosphere to the water, and as a consequence DO levels often become very low during the winter. Simultaneously with the formation of a complete ice cover the inflows to rivers become dominated by groundwater contributions. The thermal input of the incoming groundwater is extremely important in that it helps provide good spawning conditions. The 'acidity' of the snowpack is a factor; during the initial snowmelt period, the increase in hydrogen ion content of the runoff can be detrimental to the developing eggs of fall spawners. The addition or diversion of flow from streams can have either a beneficial or negative impact, depending on its influence on the thermal regime and the effect on the ice conditions. Among the tools used to manage water quality are models of rivers, reservoirs and lakes that predict their physical and thermal behavior. The models developed for non-winter periods are generally applicable to the winter period with some additional work to incorporate the effects of ice and the density inversion of water that occurs around 4 C. However, these effects are not always obvious, are often complicated, and until very recently have not been considered from a water quality viewpoint. (See also W89-13231) (Lantz-PTT)
W89-13245

DEVELOPING AN OPERATIONAL WATER TEMPERATURE MODEL FOR THE COLUMBIA RIVER SYSTEM.
Army Engineer Div. North Pacific, Portland, OR. Water Quality Section.
B. Tanovan, and R. G. Willey.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 170-184, 8 fig.

Descriptors: *Water quality control, *Reservoir operation, *Water quality management, *Model studies, *Columbia River, Management planning, Water temperature, Snake River, Decision making.

The steps taken to overcome real-life problems in developing an operational water temperature model (COLTEMP) for the relatively complex Columbia and Snake River mainstem, under stringent modeling requirements and a scarcity of data are described. To model diurnal temperature fluctuations, short duration temperature blockage and unusual thermal conditions requires the dual capability of simulating both reservoir and riverine flow conditions. These modeling requirements were weighed against the capabilities of three of the most readily available Corps models--CE-QUAL-RIV1, CE-QUAL-R1, and HEC-5Q. From a practical standpoint, however, HEC-5Q appears to be easier to handle, given the large configuration of the prototype and the need for system optimization capability. For each time step, HEC-5Q computes the entire system in one pass, before moving on to the next time step. Known limitations to the mode had to be addressed first, and include capability to: (1) handle short calculation time steps and large number of projects involved; and (2) simulate the 2-D flow conditions of the McNary Reservoir with two different inflow qualities. Input preparation and model preparation (setting a correct water accounting for the model and reconstituting the observed pool elevations at all reservoirs, and reproducing observed temperature profiles in the reservoirs and stream channels) are the final steps in this process. (See also W89-13231) (Lantz-PTT)
W89-13249

GROUND WATER MANAGEMENT PLAN FOR THE CONSTRUCTION OF THE BONNEVILLE NAVIGATION LOCK.
Army Engineer District, Portland, OR.
For primary bibliographic entry see Field 5G.
W89-13252

SIMULATION OF STEADY-STATE GROUNDWATER MOVEMENT AND SPRING FLOW IN THE UPPER FLORIDAN AQUIFER OF COASTAL CITRUS AND HERNANDO COUNTIES, FLORIDA.
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-13324

GROUNDWATER HYDROLOGY AND SIMULATED EFFECTS OF DEVELOPMENT IN SMITH CREEK VALLEY, A HYDROLOGICALLY CLOSED BASIN IN LANDER COUNTY, NEVADA.
Geological Survey, Carson City, NV.
For primary bibliographic entry see Field 2F.
W89-13363

LAND-USE POLICY AND THE PROTECTION OF GEORGIA'S ENVIRONMENT.
Georgia Univ., Athens. Carl Vinson Inst. of Government.
For primary bibliographic entry see Field 6E.
W89-13390

GEORGIA WETLANDS: TRENDS AND POLICY OPTIONS.
Georgia Univ., Athens. Carl Vinson Inst. of Government.
For primary bibliographic entry see Field 6E.
W89-13391

7. RESOURCES DATA

7A. Network Design

PLANNING GROUND WATER MONITORING FIELD PROJECTS.
SCS Engineers, Inc., Long Beach, CA.
K. H. Lister.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 3, p 101-111, 1989. 3 fig, 4 tab, 11 ref.

Descriptors: *Project planning, *Network design, *Monitoring, Personnel management, Field tests, Groundwater pollution, Water sampling, Aquifer testing, Management planning, Scheduling, Water pollution control.

Project organization problems are not uncommon in ground water monitoring projects, particularly those which occur at sites remote from the office. Successful project management depends on coordination of the personnel, supplies, and equipment necessary to carry out each phase of the project. Procedures for planning and organizing field projects involving well installation, ground water sampling, and aquifer testing are outlined. Methods are suggested that will aid the project manager in planning and scheduling field work to make efficient use of personnel and material resources. Cautions are given regarding common pitfalls of projects involving operations at remote sites, and means of avoidance are enumerated. A checklist of commonly used field equipment and supplies is provided. (Author's abstract)
W89-12873

IN-HOUSE WELL DRILLING OPERATIONS FOR A GROUND WATER MONITORING PROGRAM, SUFFOLK COUNTY, NEW YORK.
Suffolk County Dept. of Health Services, Hauppauge, NY. Groundwater Resources Bureau.
S. V. Cary, and R. Markel.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 3, p 194-199, 1989. 1 fig, 4 tab, 8 ref.

Descriptors: *Network design, *Monitoring, *Water quality, *Groundwater management, *Drilling, *New York, *Cost analysis, Water supply, Government supports, Unconsolidated aquifers, Monitoring, Oil spills, Geology, Hydrologic aspects, Logging, Governmental interrelations, Engineering personnel, Operating policies.

All public agencies involved in ground water monitoring and protection face the requirement of obtaining well drilling services consistent with their needs. Most will rely on contracted drilling services, but a limited number of agencies having responsibilities for long-term aquifer monitoring and the promulgation of monitoring standards may find that implementing an in-house well drilling program is an effective approach to achieving their groundwater protection goals. Suffolk County, located on Long Island, New York, has been operating a well drilling program for 10 years, with three levels of drilling capability to meet the requirements of characterizing and monitoring an unconsolidated regional aquifer system. The program's cost and labor requirements are substantial, but this approach has provided uniformly high-quality data and the hands-on experience needed to test drilling innovations and produce monitoring regulations that are effective and feasible. If soundly organized and run, an agency-directed drilling operation will be readily adaptable to changing needs and priorities. In Suffolk County, this has included emergency response and fuel-spill monitoring. A successful program must also include a demonstrated geologic identification and well logging capability, close laboratory support, and an experienced hydrogeological or ground water engineering staff. This approach may be suitable for other regional agencies based on their ground water conditions and water-supply protection needs. (Author's abstract)
W89-12879

MEASUREMENT AND INTERPRETATION OF THE EROSION PROCESS IN SOUTH ALPS MARLS, ON THE SCALE OF A SMALL GULLY (MEASURE ET INTERPRETATION DU PROCESSUS D'EROSION DANS LES MARINES DES ALPES DU SUD A L'ECHELLE DE LA PETHE RAVINE).
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Saint-Martin d'Heres (France). Grenoble Group.
For primary bibliographic entry see Field 2J.
W89-12881

USE OF NICHE BREADTH AND PROPORTIONAL SIMILARITY IN FEEDING TO STIPULATE RESOURCE UTILIZATION STRATEGIES IN FISH.
Herbert H. Lehman Coll., Bronx, NY. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W89-12956

ANALYSIS OF THE LINEAR PROGRAMMING GRADIENT METHOD FOR OPTIMAL DESIGN OF WATER SUPPLY NETWORKS.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
For primary bibliographic entry see Field 8A.
W89-12974

LAKE ACIDIFICATION STUDIES: THE ROLE OF INPUT UNCERTAINTY IN LONG-TERM PREDICTIONS.
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5C.
W89-12978

ANALYSIS OF NATURAL GROUNDWATER LEVEL VARIATIONS FOR HYDROGEOLOGIC CONCEPTUALIZATION, HANFORD SITE, WASHINGTON.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5E.
W89-12979

OPTIMAL PUMPING TEST DESIGN FOR THE PARAMETER IDENTIFICATION OF GROUNDWATER SYSTEMS.
California Univ., Los Angeles. Dept. of Civil Engineering.
T. Nishikawa, and W. W. G. Yeh.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1737-1747, July 1989. 11 fig, 3 tab, 17 ref. U. CA grant CDR-86-22184.

Descriptors: *Pumping tests, *Aquifer testing, *Groundwater movement, *Observation wells, *Computer models, Optimization, Systems analysis.

Research was conducted to identify a least cost pumping test design whose data will yield parameter estimates of a required reliability. The reliability is characterized by the statistical concept of the D optimality which in turn is used as the acceptability criterion for experimental design. Classically, D optimality seeks an experiment which minimizes the determinant of the parameter estimates covariance matrix, thereby maximizing their reliability. An upper bound on the determinant of the covariance matrix is derived by using the assumed asymptotic normal distribution of the parameter estimates. As formulated, the least cost problem is a nonlinear, mixed integer programming problem where the decision variables are the location of the pumping/observation well(s), the number of wells, the pumping rate, and the frequency of observations. A heuristic design algorithm was developed which seeks to minimize the number of pumping and observation wells. Since a heuristic algorithm is used and because the inverse problem is nonlinear, the algorithm will identify a local, D-optimal pumping test design. This algorithm was then applied to a hypothetical aquifer system. A sequential design algorithm was developed for circumventing the nonlinearity of the inverse problem of parameter estimation. Two case studies were performed. The first case study verified the sequential design

algorithm under noiseless conditions. The second case study gave realistic results under noisy conditions. (Author's abstract)
W89-12999

GROUND-WATER QUALITY VARIATIONS IN A SILTY ALLUVIAL SOIL AQUIFER, OKLAHOMA.
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W89-13169

MICROCOMPUTER SOFTWARE FOR THE ANALYSIS OF WATER QUALITY SAMPLING DESIGN.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
R. F. Gaugush.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 9-16, 1 fig, 3 tab, 5 ref.

Descriptors: *Sampling, *Network design, *Water quality, *Computer programs, *Data interpretation, Statistical analysis, Synoptic analysis, Computers, Analysis of variance.

Three microcomputer programs have been developed as an aid in the analysis of water quality sampling design. These programs are: (1) VARCOM, a variance component analysis program to identify the sources of variance in a sampling design; (2) CLUSTER, a cluster analysis program to identify sources of redundancy in a sampling design; and (3) ERROR, an error analysis program to reduce the error variance of a sampling design by optimally distributing sampling effort. These programs can be executed on any microcomputer capable of handling the MS-DOS operating system. (See also W89-13231) (Lantz-PTT)
W89-13233

TIERED APPROACH FOR EVALUATING SEDIMENT QUALITY AT MULTIPLE COASTAL AND RIVERINE DREDGING PROJECTS.
Army Engineer District, Portland, OR. Advance Planning Branch.
A. R. Turner.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 350-361, 5 fig, 13 ref.

Descriptors: *Sediments, *Spoil banks, *Monitoring, *Water pollution control, *Waste disposal, *Dredging, *Waste management, Rivers, Coastal waters, Toxicity, Sediment contamination, Coos Bay, Oregon, Monitoring, Biological studies, Chemical properties, Physical properties.

Several tiered or hierarchical schemes for evaluating sediment quality and toxicity potential have been developed. While they differ in specifics such as content and number of tiers, it is apparent that the tiered approach is being increasingly viewed as a logical means of designing sediment quality programs to address a wide range of toxicity concerns. As illustrated by a Coos Bay ocean disposal Site H study, a tiered evaluation scheme is applicable to monitoring as well as project evaluations. A study design to monitor bottom dispersal from a disposal site, for example, may be limited initially to Tier I physical analyses at stations within and adjacent to the site. Chemical (Tier II) or biological (Tier III) monitoring would be initiated if Tier I results showed substantial changes in sediments that would cause concern about long-term habitat changes or contaminant bioaccumulation. A benefit to this strategy in a monitoring program is that station number or sampling frequency can be increased to improve coverage of potentially impacted areas while controlling study costs. (See also W89-13231) (Lantz-PTT)
W89-13264

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN MARYLAND, DELAWARE, AND THE DISTRICT OF COLUMBIA.
Geological Survey, Towson, MD. Water Resources Div.
D. H. Carpenter, R. W. James, and D. F. Gillen.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4093, 1987. 85p, 10 fig, 13 tab, 19 ref.

Descriptors: *Network design, *Data acquisition, *Stream gaging, *Cost analysis, *Maryland, *Delaware, *District of Columbia, Error analysis, Discharge measurement, Streamflow, Regression analysis, Optimization, Flow routing.

This report documents the results of a cost-effectiveness study of the stream-gaging program in Maryland, Delaware, and the District of Columbia. Data uses and funding sources were identified for 99 continuously operated stream gages in Maryland, Delaware, and the District of Columbia. The current operation of the program requires a budget of $465,260/year. The average standard error of estimation of streamflow records is 11.8%. It is shown that this overall level of accuracy at the 99 sites could be maintained with a budget of $461,000, if resources were redistributed among the gages. (USGS)
W89-13328

7B. Data Acquisition

ANALYTICAL CHEMISTRY OF ORGANIC COMPOUNDS PRESENT IN WATER.
Ames Lab., IA.
For primary bibliographic entry see Field 5A.
W89-12205

COMPARISON OF TECHNIQUES FOR ASCERTAINING THE IMPACT OF A THERMAL DISCHARGE ON THE TEMPERATURE OF TIDAL RECEIVING WATERS.
Queensland Electricity Commission, Brisbane (Australia). Environmental Investigations Branch.
For primary bibliographic entry see Field 5C.
W89-12229

CORRECT USE OF MEMBRANE NITROCELLULOSE FILTERS IN WATER MICROBIOLOGY (O KORREKTNOSTI ISPOL'ZOVANIIA MEMBRANNYKH NITROTSELLIULOZNYKH FIL'TROV V VODNOI MIKROBIOLOGII).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5A.
W89-12278

EFFECTS OF BOTTLE SIZE IN DETERMINATIONS OF PRIMARY PRODUCTIVITY BY PHYTOPLANKTON.
University Coll. of North Wales, Menai Bridge. School of Ocean Sciences.
G. E. Fogg, and O. Calvario-Martinez.
Hydrobiologia HYDRB8, Vol. 173, No. 2, p 89-94, March 22, 1989. 1 fig, 1 tab, 18 ref.

Descriptors: *Sampling, *Phytoplankton, *Primary productivity, *Radioactivity techniques, Carbon radioisotopes, Seasonal variation, Menai Strait.

Determinations of primary productivity were made by the radiocarbon method at regular intervals over a year in samples taken from the eutrophic waters of the Menai Strait, North Wales, and contained in bottles of capacities from 135 ml up to 2290 ml. Fixation per unit volume in particulate matter retained by 0.45 micron pore size membrane filters was independent of bottle size over most of the year. There was a consistent divergence, however, during the period of rapid phytoplankton growth in the spring, when small bottles gave up to three times higher values than large ones. While the cause of this particular result is not apparent, there are several possible effects of bottle size on primary productivity determinations: (a) enclosure in a bottle might reduce the activity of the bacterioplankton, the chief consumers of free amino acids, by reducing the availability of these substrates; (b) turbulence patterns and sedimentation of plankton are vastly different between the natural environment and a bottle; in a small undisturbed bottle the larger plankton may settle to the bottom whereas in a larger bottle the bulk may still remain in suspension; (c) concentration of light by refraction may be more intense in small than in large bottles, especially if they are not immersed in water, and this may have appreciable effects on photosynthesis; (d) the overall metabolism of the plankton may be altered if the dynamic balance between heterotrophic and phototrophic components is affected by the surface of the bottle. (Sand-PTT)
W89-12310

FIELD EVALUATION OF A MICRO-EXTRACTION TECHNIQUE FOR MEASURING CHLOROPHYLL IN LAKEWATER WITHOUT FILTRATION.
Wisconsin Univ.-Madison. Center for Limnology.
E. Greenberg, and C. J. Watras.
Hydrobiologia HYDRB8, Vol. 173, No. 3, p 193-197, March 29, 1989. 2 fig, 1 tab, 17 ref. NSF Grant DEB 8012313 and EPA Cooperative Agreement CR810961-01.

Descriptors: *Sampling, *Water analysis, *Phytoplankton, *Biomass, *Chlorophyll, *Chemical analysis, *Oligotrophic lakes, *Mesotrophic lakes, Extraction technique, Wisconsin, Assay.

A recently described technique for measuring chlorophyll biomass in small water samples was evaluated on a set of lakes in northcentral Wisconsin. Since the new technique requires only 1.5 ml of unconcentrated lake water, it eliminates several steps and sources of error in the traditional protocol and permits a very high degree of spatial precision for point estimates of chlorophyll concentration. For the midsummer plankton of six lakes (oligotrophic to mesotrophic), agreement between the new whole-water micro-extraction and the traditional filtered-sample techniques was quite good but recovery by the whole-water method was generally higher, perhaps because some plankton passed through the filters. Using unmodified, generally available instrumentation, limits of detection were about 0.3 microgram chlorophyll/L in situ; the literature suggests that these limits can be improved easily by a factor of three. The results indicate that whole-water micro-extraction of chlorophyll is an acceptable technique to use for many lakes. (Author's abstract)
W89-12319

DYNAMICS OF ZOOPLANKTON COMMUNITY IN ENCLOSURES OF DIFFERENT TYPES IN A SHALLOW EUTROPHIC LAKE.
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
For primary bibliographic entry see Field 2H.
W89-12325

EVALUATION OF THE DEGREE OF CITRULLINE INTERFERENCE IN THE SPECTROPHOTOMETRY OF UREA WITH DIACETYL MONOXIME IN NATURAL WATERS.
Yamagata Univ. (Japan). Dept. of Chemistry.
Y. Satoh, and T. Katoh.
Japanese Journal of Limnology RIZAAU, Vol. 50, No. 1, p 39-43, 1989. 3 fig, 1 tab, 14 ref.

Descriptors: *Water analysis, *Spectrophotometry, *Ureas, *Chemical analysis, *High performance liquid chromatography, *Eutrophic lakes, Citrulline interference, Lake Suwa, Japan.

THe degree of citrulline interference in the spectrophotometry of urea with diacetyl monoxime was determined, and the color products of the method were separated with high performance liquid chromatography. From the peak heights of the color products of urea and citrulline with diacetyl monoxime, the citrulline interference can be moderately high, but in most cases it is insignificant. In 59 out of 70 water samples from eutrophic Lake Suwa in Japan, the concentration of citrulline was under the determination limit (<0.01 microgram-at-N/l urea equivalent). In the rest, citrulline

contributed an average 8% (range 5-19%) to the color developed. (Author's abstract)
W89-12326

IMPROVING THE DETECTION OF AGRICULTURAL DROUGHT: A CASE STUDY OF ILLINOIS CORN PRODUCTION.
Illinois State Water Survey Div., Champaign. Climatology and Meteorology Section.
W. E. Easterling, S. A. Isard, P. Warren, P. Guinan, and M. Shafer.
Agricultural and Forest Meteorology AFMEEB, Vol. 43, No. 1, p 37-47, June 1988. 2 fig, 2 tab, 18 ref. NSF Grant ATM 84-13043.

Descriptors: *Soil-water-plant relationships, *Crop production, *Drought, *Moisture deficiency, *Corn, *Illinois, *Agricultural hydrology, Sensitivity analysis, Crop yield, Palmer indices, Monitoring, Case studies.

Too little attention has been given to the manner in which drought detection and monitoring indices are applied in agricultural settings. In this research, results of an Illinois corn-weather sensitivity analysis were used to select values of the moisture anomaly index (MAI or z) and related Palmer drought severity index (PDSI or X) to match periods of maximum moisture (i.e., drought) sensitivity in the corn growing season. These partial growing season values were compared with their equivalent growing season average for 12 Illinois sites to evaluate which were most effective in explaining interannual variations in detrended corn yields. Results indicate that the Palmer indices calculated for only the peak corn moisture sensitivity periods outperformed the mean growing season Palmer indices in accounting for 1960-1983 interannual variations in corn yields by a factor of more than 2. (Author's abstract)
W89-12329

CONTINUOUS FLOW METHOD FOR SIMULTANEOUS DETERMINATION OF MONOCHLORAMINE, DICHLORAMINE, AND FREE CHLORINE: APPLICATION TO A WATER PURIFICATION PLANT.
Osaka Prefectural Univ., Sakai (Japan). Lab. of Environmental Chemistry.
For primary bibliographic entry see Field 5A.
W89-12379

DISTRIBUTION OF ATMOSPHERIC POLYCHLORINATED BIPHENYL CONGENERS BETWEEN VAPOR PHASE, AEROSOLS, AND RAIN.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 5B.
W89-12381

ANALYSIS OF INORGANIC AND ORGANIC CHLORAMINES: DERIVATIZATION WITH 2-MERCAPTOBENZOTHIAZOLE.
Minnesota Univ., Duluth. Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W89-12388

EFFECT OF PRELOADING ON THE SCALE-UP OF GAC MICROCOLUMNS.
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5F.
W89-12392

COMPUTERIZING THE PLANNING, ANALYSIS AND MAINTENANCE OF WATER SYSTEMS.
Psomas and Associates, Santa Monica, CA.
For primary bibliographic entry see Field 6A.
W89-12398

MAPPING TECHNIQUES TO CUT SMALL HYDRO COSTS.
Balfour Beatty Engineering Ltd., Kent (England).
J. R. Queening, G. P. Birch, and C. M. Willers.
International Water Power and Dam Construction IWPCDM, Vol. 41, No. 6, p 23, 26-28, 30-31, June 1989. 4 fig, 2 tab, 3 ref.

Descriptors: *Mapping, *Hydroelectric power, *Aerial photography, *Cost analysis, Photogrammetry, Economic aspects, Peru, Thailand, Surveys, Vegetation.

A low-cost photogrammetric method has been developed to improve on the quality of existing mapping for studies of small hydro projects in Peru and Thailand. The method, developed in conjunction with specialist photogrammetrists, geologists, and civil engineers, makes use of existing air photography, mapping, and survey data to produce large-scale mapping appropriate to the scale and stage of investment of the project. The method involves an unusual application of conventional photogrammetry. The low cost method is outlined and contrasted with the conventional mapping approach for small and large projects. Its limitations and savings in cost and time are discussed. It is concluded that the low cost air survey method optimizes the benefits from conventional field survey and photogrammetry to give an economical means of large-scale mapping for small projects. By conventional methods, 1:5000 scale mapping for small projects is usually uneconomic. Maps provided by the low-cost method described have proved eminently suitable for identifying attractive small hydro sites and as base mapping for site reconnaissance visits, desk studies, and for defining field survey requirements. By extending the technique to mapping at 1:500 scale, the opportunity arises to reduce field surveys in the early stages of a project, while providing maps with detail and accuracy appropriate for feasibility and tender purposes. (Doria-PTT)
W89-12410

MEASUREMENT OF NEAR-SURFACE SOIL MOISTURE WITH A HYDROGENOUSLY SHIELDED NEUTRON PROBE.
Alberta Univ., Edmonton. Dept. of Soil Science.
D. S. Chanasyk, and M. A. Naeth.
Canadian Journal of Soil Science CJSSAR, Vol. 68, No. 1, p 171-176, February 1988. 2 fig, 2 tab, 15 ref.

Descriptors: *Nuclear moisture meters, *Soil water, *Measuring instruments, *Moisture probe, Radiation, Performance evaluation, Economic aspects, Vegetation, Hydrogen, Litter, Calibrations.

Numerous techniques for measuring near-surface soil moisture with a neutron probe have been reported. Placing the neutron probe horizontally on the ground surface within a hydrogenous shield has been discussed theoretically, but field adaptations have not. Such a shield was designed and used, yielding measurements of near-surface soil moisture quickly and accurately. The shield prevents the complete escape of fast neutrons emanating from the source in an upward direction and scatters the neutrons back in a constant manner, while protecting the operator from radiation exposure. Variations in counts could then be attributed to changes in soil moisture only. The surface shield method has been incorporated in a routine manner into the measurement of soil moisture with depth. The shield is easy to use and can be used on its own to determine near-surface soil moisture in a nondestructive manner. Many readings can be taken quickly, facilitating statistical analysis. Use of the shield is somewhat limited in areas where vegetation is tall and/or litter amounts are high, raising the shield off the ground. Resulting erroneous readings are easily spotted because of negative moisture contents predicted by the calibration equation. A modification in design would allow its use between rows of crops if necessary. The in-shield readings can also be calibrated for other depths of interest using cores of different lengths. (Doria-PTT)
W89-12436

ESTIMATING SPATIAL VARIATIONS OF SOIL WATER CONTENT USING NONCONTACTING ELECTROMAGNETIC INDUCTIVE METHODS.
Guelph Univ. (Ontario). Dept. of Land Resource Science.
R. G. Kachanoski, E. G. Gregorich, and I. J. van Wesenbeeck.
Canadian Journal of Soil Science CJSSAR, Vol. 68, No. 4, p 715-722, November 1988. 2 fig, 3 tab, 13 ref.

Descriptors: *Soil moisture meters, *Geophysics, *Soil water, *Conductivity, *Measuring instruments, Magnetic studies, Electromagnetic waves, Soil texture, Reflectance, Clays, Regression analysis, Soil science, Estimating, Spatial distribution.

The relationships among the spatial variations of soil water content, soil texture, soil solution electrical conductivity, and bulk soil electrical conductivity were examined for a field characterized by net drainage and low concentrations of dissolved electrolytes. Bulk soil electrical conductivity was measured over various depths at 52 locations within a 1.8-ha field using noncontacting electromagnetic inductive meters. Soil water content (0-0.5 m depth) was measured at the same locations using the time domain reflectometry method. Measurements of soil texture and soil solution conductivity were obtained from core samples from 37 of the sampling locations. Soil water content at the site ranged from 0.06 to 0.36 cu m/cu m. Clay content ranged from 2.5 to 44% and bulk soil electrical conductivity ranged from 0.0 to 0.21 S/m. Significant correlation existed among almost all of the measured variables. Regression analysis indicated soil solution conductivity had no effect on measured bulk soil electrical conductivity for soil water contents less than 0.25 cu m/cu m. Bulk soil electrical conductivity explained 96% of the spatial variation of soil water content independent of a wide range of soil texture. Autocorrelations of soil water content were similar to autocorrelations for bulk soil electrical conductivity. Under conditions similar to those in the study area, it should be possible to infer spatial variations in soil water content quickly by measuring bulk electrical conductivity using noncontacting electromagnetic inductive meters. (Author's abstract)
W89-12451

APPLICATION OF LOW-ENERGY SOURCE SEISMIC REFRACTION TO INVESTIGATION OF UNCONSOLIDATED SEDIMENTS, NEGRIL BEACH, JAMAICA.
University of the West Indies, Kingston (Jamaica). Dept. of Geology.
M. D. Hendry, and L. A. Henry.
Journal of the Geological Society of Jamaica, Vol. 23, p 17-24, 1985. 6 fig, 8 ref.

Descriptors: *Geological surveys, *Beach profiles, *Seismology, *Subsurface mapping, *Karst, Geologic history, Field tests, Boreholes, Sand, Clays, Gravel, Limestone, Cost-benefit analysis, Jamaica.

Geological investigations of the beach margin at Negril, in western Jamaica, made use of a portable hammer seismograph. An extended picture of subsurface structure was obtained up to 30 meters below ground level, with control on interpretation provided by a number of boreholes. A general three-layer sequence was defined, including sand, clay, and gravelly clay and bedrock limestone, the latter displaying a well-defined hummocky surface, presumably a karst relic of former sub-aerial exposure. While a number of problems accompany the field use of the seismograph, it is a cost-effective way of gaining a longitudinal picture of subsurface features. (Fish-PTT) (Author's abstract)
W89-12460

EVALUATION OF SETTLEABILITY OF ACTIVATED SLUDGE USING A SLUDGE SETTLING ANALYZER.
Meidensha Corp., Tokyo (Japan). Development Div.
For primary bibliographic entry see Field 5D.
W89-12490

SELECTION OF AN ANTIBIOTIC-RESISTANT STRAIN OF BACILLUS SUBTILIS VAR.

NIGER (B. GLOBIGID FOR USE AS A TRACER IN MICROBIALLY RICH WATERS.
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Mechanical and Mfg. Systems Engineering.
For primary bibliographic entry see Field 5D.
W89-12493

WATER CHARACTERISTICS.
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W89-12504

CONTINUOUS MONITORING, AUTOMATED ANALYSIS, AND SAMPLING PROCEDURES.
Oak Ridge National Lab., TN. Chemical Technology Div.
R. L. Jolley, and A. L. Rivera.
Journal-Water Pollution Control Federation JWPFA5, Vol. 61, No. 6, p 782-785, June 1989. 38 ref.

Descriptors: *Pollutant identification, *Literature review, *Monitoring, *Sampling, *Wastewater treatment, *Denitrification, *Toxic wastes, Mercury, Organic compounds, Stabilization ponds, Biological oxygen demand, Chromium, Coagulation, Flocculation, Leachate.

Monitoring and control strategies for denitrification, activated-sludge processes, aerobic wastewater treatment processes, identification and quantification of volatile compounds in leachate from a superfund site, anaerobic digester stability, and anaerobic sludges are reviewed. In addition determination methods are described for detergents and mercury. Continuous monitoring applications have been developed and evaluated for rapid determination of biological oxygen demand, coagulation and flocculation, alum sludge conditioning, biomass development in biologically treated wastewaters, anaerobic digestion, chromium segregation, and industrial wastewater. Sampling systems discussed include: a two-stage sealed system for sampling organic compounds in wastewater; a water column method for development of effluent quality data and determination of performance of waste stabilization ponds; and sampling optimization using a relative semivariogram. (White-Reimer-PTT)
W89-12505

ANALYTICAL DETERMINATION OF ORTHOPHOSPHATE IN WATER.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
O. Broberg, and K. Pettersson.
Hydrobiologia HYDRB8, Vol. 170, p 45-59, December 1988. 4 fig, 7 tab, 87 ref.

Descriptors: *Reviews, *Orthophosphates, *Pollutant identification, *Water analysis, Performance evaluation, Reliability, Comparison studies, Eutrophication, Molybdenum blue method, Enzymes, Chromatography, Isotope studies.

Methods for orthophosphate determination and the problems of interferences are reviewed. An important group of methods utilizes the phosphomolybdate complex. The complexation step, the reduction step, and the extraction step are treated separately and alternative procedures are compared. Methods involving ion association complexes are not used commonly in water analyses today. Enzymatic methods for orthophosphate analysis have been developed recently and are ready for application in selected water bodies. Flame spectroscopic, fluorometric, gas chromatographic, ion-exclusion chromatographic, inductively coupled, and other methods, including radiobiological methods, also are available. Despite the development of a number of techniques, the most commonly used and reliable method remains the molybdenum blue method as modified in 1962 by Murphy and Riley. The need for specific and sensitive methods is particularly strong in investigations of phosphorus turnover and phosphorus limitation in natural waters. For these purposes the enzymatic phosphatase methods have advantages due to their specificity for orthophosphate. They may represent an alternative to the molybdenum blue method. (See also W89-12578) (Author's abstract)
W89-12577

PHOSPHORUS IN INTERSTITIAL WATER: METHODS AND DYNAMICS.
Swedish Environmental Research Inst., Stockholm.
For primary bibliographic entry see Field 5B.
W89-12580

EMPIRICAL AND THEORETICAL MODELS OF PHOSPHORUS LOADING, RETENTION AND CONCENTRATION VS. LAKE TROPHIC STATE.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W89-12589

CLASSIFICATION AND ORDINATION OF MACROINVERTEBRATE ASSEMBLAGES TO PREDICT STREAM ACIDITY IN UPLAND WALES.
Welsh Water Authority, Bridgend. South Eastern District Lab.
For primary bibliographic entry see Field 5A.
W89-12596

DETERMINATION OF TOTAL ORGANIC CARBON IN WATER IN THE FORM OF CARBAMATE BY MEANS OF A SIMPLE DENUDER/ELECTROLYTIC CONDUCTIVITY FLOW CELL SYSTEM.
Kozponti Kemiai Kutato Intezete, Budapest (Hungary).
I. Gacs, and K. Payer.
Analytica Chimica Acta ACACAM, Vol. 220, No. 1, p 1-11, May 1 1989. 9 fig, 4 tab, 30 ref.

Descriptors: *Chemical analysis, *Organic carbon, *Carbamates, *Measuring instruments, *Conductivity, *Water analysis, Volatility, Organic compounds, Carbon, Absorption, Electrochemistry.

A simple and sensitive technique for measuring both volatile organic carbon (VOC) and total organic carbon (TOC) in water is presented. The VOC fraction is stripped by a stream of oxygen and subjected to high-temperature catalytic combustion after removing the carbon dioxide, obtained from inorganic constituents at pH < or = 2, with lithium hydroxide. The residual non-volatile organics (NVOC) are converted into carbon dioxide by injecting an aliquot of the stripped sample directly into the combustion tube. The carbon dioxide derived from the VOC/NVOC is preconcentrated from the gas stream by absorption in a stainless-steel capillary tube coated with a 2 M ethanolic solution of 3-methoxyproplylamine. The carbamate formed in the liquid film is then eluted with a stream of the absorbent circulating through a microelectrolytic conductivity detector. The change in specific conductance due to the presence of the carbamate in the effluent stream is linearly related to the amount of VOC/NVOC/TOC up to 4.5 micrograms of carbon. The limit of detection for VOC is 0.5 micrograms/l and for NVOC it is 100 micrograms/l. A simple determination takes 5 min. The precision was better than 5% (P = 95%) for 0.5-4.5 micrograms of carbon. The method is also suitable for the determination of total carbon and inorganic carbon in water. (Author's abstract)
W89-12600

STUDIES OF ESTUARINE SEDIMENT DYNAMICS USING 137CS FROM THE TJERNOBYL ACCIDENT AS A TRACER.
Umea Univ. (Sweden). Dept. of Physical Geography.
For primary bibliographic entry see Field 2J.
W89-12603

PREDICTING REAERATION RATES IN TEXAS STREAMS.
Texas Water Commission, Austin. Standards and Evaluation Section.
For primary bibliographic entry see Field 2E.
W89-12620

HYBRIDIZATION OF DNA PROBES WITH WHOLE-COMMUNITY GENOME FOR DETECTION OF GENES THAT ENCODE MICROBIAL RESPONSES TO POLLUTANTS: MER GENES AND HG(2+) RESISTANCE.
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W89-12659

AUTOMATIC ON-LINE GROWTH ESTIMATION METHOD FOR OUTDOOR ALGAL BIOMASS PRODUCTION.
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Electrical and Computer Engineering.
For primary bibliographic entry see Field 2H.
W89-12668

SIGNIFICANCE OF THE AQUATIC MOSSES IN BIOGEOCHEMISTRY.
Sri Venkateswara Univ., Tirupati (India). Dept. of Geology.
E. A. V. Prasad, A. N. Raju, G. Sankaranna, and V. Raghu.
Current Science CUSCAM, Vol. 58, No. 5, p 225-227, March 5 1989. 1 tab, 29 ref.

Descriptors: *Pollutant identification, *Aquatic plants, *Mosses, *Heavy metals, *Bioaccumulation, *Mine wastes, *Bioindicators, Monitoring, Absorption, Accumulation, Mica pegmatite, Barytes, Lead.

Aquatic plants, such as mosses, water lilies, water hyacinth, duckweed etc. are important components of aquatic ecosystems throughout the world. In order to assess this significance, a biogeochemical study of mosses was conducted in which five samples of mosses from surface water bodies were collected from three mining areas of mica pegmatite, barytes and lead in Andhra Pradesh. The results revealed a striking enrichment of: (a) boron, uranium, strontium, vanadium, and cerium in the mica pegmatite area; (b) barium, zinc, and cobalt in the barytes mining area; and (c) lead and manganese in the lead mining area. In view of the unusually high absorption and accumulation of heavy metals in mosses and other bryophytes from water bodies, these plants have been suggested as indirect indicators of mineralization in catchment areas of drainage systems. Based on these results it has been concluded that aquatic mosses are useful in geochemical and agricultural reconnaissance surveys, monitoring of toxic heavy metals including radioactive pollutants in water bodies, and water treatment. (White-Reimer-PTT)
W89-12676

STANDARD HEMISPHERES AS INDICATORS OF FLOW CHARACTERISTICS IN LOTIC BENTHOS RESEARCH.
Karlsruhe Univ. (Germany, F.R.). Zoologisches Inst.
For primary bibliographic entry see Field 2E.
W89-12682

LIMITATIONS OF THE IODOMETRIC DETERMINATION OF OZONE.
Miami Univ., Oxford, OH. Hughes Labs.
G. Gordon, K. Rakness, D. Vornehm, and D. Wood.
Journal of the American Water Works Association JAWWA5, Vol. 81, No. 6, p 72-76, June 1989. 1 fig, 6 tab, 18 ref.

Descriptors: *Ozone, *Chemical analysis, *Iodometry *Spectrophotometry, Massachelein modification method, Comparison studies, Standard methods, Flow rates, Reproducibility, Ultraviolet radiation, Performance evaluation.

Three popular variations of the iodometric determination of ozone were investigated using a spectrophotometric ozone monitor as the referee method. Determinations carried out with a neutral buffered potassium iodide reagent acidified to pH 2 with sulfuric acid were observed to give values that were 15 to 30 percent higher than those obtained with the unbuffered potassium iodide and Massachelein modification methods relative to the referee method. The system-specific character of the iodometric methods can most likely be attributed to slight variations in the sampling parameters. For example, the flow rate of the gas sample through the reagent solution was shown to have a marked effect on the determination. The iodometric determination of ozone can be reproduced when carried out under strictly controlled conditions. When used under defined procedural conditions, either the potassium iodide or Massachelein modification methodology may be useful as an independent check of the ultraviolet monitor, such as within plus or minus 3-5%. However the evidence that microscopic details of the sample bubble passing through the reagent solution can affect the determination makes the iodometric determination not a good candidate as a standard method for ozone determination. (White-Reimer-PTT)
W89-12696

TECHNICAL NOTE: ELIMINATING INTERFERENCES IN THE DPD METHOD FOR RESIDUAL OZONE.
A. T. Palin.
Journal of the American Water Works Association JAWWA5, Vol. 81, No. 6, p 102, June 1989. 2 tab, 5 ref.

Descriptors: *Water treatment, *Ozone, *Testing procedures, *DPD method, Interference, Comparison studies, Oxidation, Drinking water, Potassium iodide, Hydrogen peroxide.

In the DPD (diethyl-p-phenylene diamine) method for the determination of residual ozone, some interference may occur from trace amounts of hydrogen peroxide and similar oxidants that may have formed during the ozonation process. To check the response of the DPD method to residual ozone using less than the currently specified amount of potassium iodide, comparative results were obtained for deionized water and drinking water. After ozonation, tests were carried out using both the full amount of potassium iodide and a reduced amount of 50 mg/L. No differences were observed for either water between the two concentration of potassium iodide used over an ozone range up to 0.5 mg as O3/L. It is recommended that the specified amount of potassium iodide to be used along with the indicator in the DPD method should be 50 mg, or approximately 1 mL of 5 percent KI solution, per 100-mL sample. The stoichiometric equivalent in terms of O3 is 72 mg/L. (White-Reimer-PTT)
W89-12700

MEASUREMENT AND DISTRIBUTION OF DISSOLVED NUCLEIC ACIDS IN AQUATIC ENVIRONMENTS.
Hawaii Univ., Honolulu. Dept. of Oceanography.
D. M. Karl, and M. D. Bailiff.
Limnology and Oceanography LIOCAH, Vol. 34, No. 3, p 543-558, May 1989. 10 fig, 5 tab, 38 ref. NSF grants OCE 86-00462 (VERTEX), OCE 83-51751 (PYI), and DPP 85-18748 (RACER).

Descriptors: *Nucleic acids, *Aquatic environment, *Organic matter, Chemical analysis, Cetyltrimethylammonium bromide, Spatial distribution.

Nucleic acids (DNA and RNA) are ubiquitous components of the dissolved organic matter (DOM) pool of all oceanic, neritic, estuarine, and freshwater habitats studied to date. A new method for the quantitative determination of dissolved nucleic acids (DNA and RNA) in water and sediment samples was developed, evaluated, and utilized in a study of various marine and freshwater ecosystems. Under appropriate reaction conditions, dissolved DNA (D-DNA) and dissolved RNA (D-RNA) are efficiently removed from solution with the addition of cetyltrimethylammonium bromide (CTAB) and subsequent formation of insoluble CTA-nucleic acid salts. The insoluble salts are collected, by filtration, onto glass-fiber filters and analyzed for DNA and RNA with fluorometric and colorimetric procedures, respectively. The performance of this CTAB method is simple, reliable, and reproducible for measuring dissolved nucleic acids in natural aquatic environments. For the ecosystems investigated herein, D-DNA and D-RNA concentrations ranged from 0.56 to 88 microg/L and 4.03 to 871 microg/L; the ratio of D-RNA to D-RNA ranged from 4.1 to 11.5. (Author's abstract)
W89-12703

IMPLEMENTING A SCADA SYSTEM--TRIALS, TRIBULATIONS, TRIUMPH.
Anne Arundel County Dept. of Utilities, Glen Burnie, MD.
For primary bibliographic entry see Field 5D.
W89-12709

SPECTRAL BRIGHTNESS OF INLAND RESERVOIRS AND ITS CORRELATION WITH THE PHYTOPLANKTON CONTENTS AND HYDRO-OPTICAL CHARACTERISTICS (SPECTRAL' NAIA IARKOST' VNUTRENNIKH VODOEMOV I II VZAIMOSVAIZ' S SODERZHANIEM FITOPLANKTONA I GIDROOPTICHESKIMI KHARAKTERISTIKAMI).
Institute of Biophysics, Krasnoyarsk (USSR).
For primary bibliographic entry see Field 2H.
W89-12726

INTEGRATED RETENTION/SPECTROPHOTOMETRIC DETECTION IN FLOW-INJECTION ANALYSIS: DETERMINATION OF IRON IN WATER AND WINE.
Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
F. Lazaro, M. D. Luque-DeCastro, and M. Valcarcel.
Analytica Chimica Acta ACACAM, Vol. 219, No. 2, p 231-238, April 15, 1989. 3 fig, 3 tab, 21 ref. CICyT grant no. PA86-0146.

Descriptors: *Iron, *Water analysis, *Measuring instruments, *Spectrophotometry, Retention, Injection, Natural waters, Flow-injection, Wine, Pollutant identification, Resins, Colorimetry, Fluorometry, Catalysis.

An integrated retention/spectrophotometric method is proposed for the determination of iron based on the Fe(III)-thiocyanate complex. Different types of measurements (peak height, absorbance increment, tangent curve) are shown to have their particular advantages. The method is applied to the determination of iron in natural water and wine, with an average recovery of 100.3% and 98.8% and an average deviation of the recovery of 2.5% and 1.6%, respectively. The proposed flow-injection method, based on simultaneous retention and detection, possesses several advantages. It provides fast pre-concentration of the analyte on the ion exchanger and avoids the blank signal from colored samples. The sample throughput is high compared with that of any other pre-concentration technique. The method is highly sensitive with a determination limit of 10 ng/l. The fading of the color of the iron-thiocyanate complex has no influence because the measurements are fast. Application of the fluorometric determination of catalysts retained on the exchanger and on other substrates, such as XAD resins and Sephadex, will give this method even wider scope. (Miller-PTT)
W89-12727

MEASUREMENT OF NATURAL TRACE DISSOLVED HYDROCARBONS BY IN SITU COLUMN EXTRACTOR EXTRACTION: AN INTERCOMPARISON OF TWO ADSORPTION RESINS.
Institute of Ocean Sciences, Sidney (British Columbia). Ocean Chemistry Div.
M. B. Yunker, F. A. McLaughlin, R. W. MacDonald, W. J. Cretney, and B. R. Fowler.
Analytical Chemistry ANCHAM, Vol. 61, No. 13, p 1333-1343, July 1, 1989. 7 fig, 6 tab, 24 ref.

Descriptors: *Water analysis, *Natural waters, *Separation techniques, *Hydrocarbons, *Resins, *Trace levels, Adsorption, Column extraction, Polycyclic aromatic hydrocarbons, In situ tests, Comparison studies.

Chromosorb T and XAD-2 resins are compared for the in situ extraction of alkaline and polycyclic aromatic hydrocarbons (PAHs) from freshwater and seawater. In column efficiency experiments, Chromosorb T yielded higher recoveries than XAD-2 for n-alkanes at 3 and 0.6 ng/L concentrations per component. Chromosorb T columns gave good recoveries for PAHs of three or more rings (0.4 ng/L per component) and XAD-2 for PAhs of four and more rings (0.06 ng/L per component). Lower molecular weight PAHs were recovered poorly by Chromosorb T and contaminated by XAD-2. Principal component analysis (PCA) discriminated well between Chromosorb T and XAD-2 dissolved hydrocarbon in situ samples and their respective blanks. The PCA models could also distinguish between the groups of samples collected with each resin. Between-resin difference was more important than sampling location for hydrocarbon composition; this difference in resin adsorption characteristics shows up dramatically in the mean sample and blank plots for the hydrocarbons. The majority of blank-corrected XAD-2 alkane concentrations were below the limit of detection. In contrast, the majority of the alkanes below triacontane were quantifiable for the samples on Chromosorb T. PAHs in the phenanthrene to chrysene range gave comparable results for the two resins. The Chromosorb T in situ methodology provides the first dissolved hydrocarbon measurements that are unquestionably the measured mean blank. With this technique, individual alkanes and PAHs at pg/L concentrations in natural waters can be quantified. (Author's abstract)
W89-12730

EXTRACTION AND ISOLATION OF PHENOXY ACID HERBICIDES IN ENVIRONMENTAL WATERS USING TWO ADSORBENTS IN ONE MINICARTRIDGE.
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Chemica.
For primary bibliographic entry see Field 5A.
W89-12731

AUTOMATED SLURRY SAMPLE INTRODUCTION FOR ANALYSIS OF A RIVER SEDIMENT BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY.
Perkin-Elmer Corp., Norwalk, CT.
M. S. Epstein, G. R. Carnick, W. Slavin, and N. J. Miller-Ihli.
Analytical Chemistry ANCHAM, Vl. 61, No. 13, p 1414-1419, July 1, 1989. 5 fig, 3 tab, 7 ref.

Descriptors: *Measuring instruments, *Sample preparation, *Rivers, *Sediments, *Heavy metals, *Atomic absorption spectrophotometry, Prototypes, Lead, Manganese, Arsenic, Iron, Zeeman effect, Graphite furnace, Automation, Slurries, Standards.

A prototype automated slurry introduction (SSI) system was used with a graphite furnace atomic absorption spectrometer (GFAAS) and Zeeman-effect background correction to determine lead, manganese, arsenic, and iron in a standard reference material river sediment (SRM 2704). Different methods of slurry preparation were tested, optimum analysis parameters were determined, and sources of variability in the GFAAS measurements were characterized. Measurement variability was found to increase in proportion to the percent of analyte not extracted in the aqueous phase of the slurry solution and was highly dependent on the homogeneity of analyte distribution in the sample. Analytical results for the four elements determined in SRM 2074 were in good agreement with certified values and confirm the utility of SSI combined with GFAAS for analysis of a complex matrix. (Author's abstract)
W89-12732

EVALUATION OF ATP PHOTOMETER FOR TOXICITY TESTING USING MICROTOX LUMINESCENT BACTERIAL REAGENT.
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5D.
W89-12738

PERIPHYTON, BENTHIC INVERTEBRATES AND FISHES AS BIOLOGICAL INDICATORS OF WATER QUALITY IN THE EAST BRANCH BRANDYWINE CREEK.
Pennsylvania Dept. of Environmental Resources, Norristown.
For primary bibliographic entry see Field 5A.
W89-12752

COMPARATIVE ANALYSIS OF POLYCHLORINATED DIBENZO-P-DIOXIN AND BIBENZOFURAN CONGENERS IN GREAT LAKES FISH EXTRACTS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY AND IN VITRO ENZYME INDUCTION ACTIVITIES.
Texas A and M Univ., College Station. Dept. of Veterinary Physiology and Pharmacology.
For primary bibliographic entry see Field 5A.
W89-12757

NICKEL ABSORPTION AND KINETICS IN HUMAN VOLUNTEERS.
Connecticut Univ. Health Center, Farmington. School of Medicine.
For primary bibliographic entry see Field 5B.
W89-12765

REMOVAL OF DIMETHYL SULFIDE, METHYL MERCAPTAN, AND HYDROGEN SULFIDE BY IMMOBILIZED THIOBACILLUS THIOPARUS TK-M.
Fermentation Research Inst., Yatabe (Japan).
For primary bibliographic entry see Field 5D.
W89-12775

VIRAL MULTICLONING PROCEDURE AND REPLICATES TECHNIQUE.
Centre de Recherche et de Controle des Eaux de Paris (France).
For primary bibliographic entry see Field 5A.
W89-12791

EVALUATION OF MANUFACTURED INOCULA FOR USE IN THE BOD TEST.
Trinity Coll., Dublin (Ireland). Environmental Sciences Unit.
For primary bibliographic entry see Field 5A.
W89-12870

POTENTIOMETRIC DETERMINATION OF FLUORIDE AND IODIDE IN NATURAL AND PROCESSED WATERS OF BAHRAIN USING ION-SELECTIVE ELECTRODES.
Bahrain Univ., Manama. Dept. of Chemistry.
A. Y. Ali-Mohamed, and S. G. A. Jamali.
Water Research WATRAG, Vol. 23, No. 5, p 659-662, May 1989. 3 fig, 4 tab, 10 ref.

Descriptors: *Water analysis, *Fluorides, *Iodides, Toxicity, Brackish water, Reverse osmosis, Ion exchange, Natural waters, Multistage flash distillation, Potentiometric level, Chemical oxygen demand, Iodine, Distillation.

To assess the natural availability of fluoride and iodide in Bahrain, natural and processed waters which included groundwater, tap waters, Adari Lake water and streams and waters from reverse osmosis, ion-exchange, multistage flash desalination and solar desalination plants, in addition to blended waters, were monitored for 3 months (October-December 1985). The fluoride ion concentration ranges from 0.45 to 1.51 +or-0.26 milligrams/cu dm in natural waters; 0.003 to 0.33 +or-0.016 milligrams/cu dm in the processed waters and 0.15 to 0.24 +or-0.095 milligrams/cu dm in the blended waters. As for the iodide ion, concentration ranges from 0.02 to 1.08 +or-0.07 milligrams/cu dm in natural waters; 0.01 to 0.02 +or-0.002 milligrams/cu dm in both processed and blended water. (Author's abstract)
W89-12871

APPLICATION OF TEMPERATURE AND ELECTRICAL-CONDUCTIVITY LOGGING IN GROUND WATER MONITORING.
Whitman Companies, Inc., East Brunswick, NJ.
A. Michalski.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 3, p 112-118, 1989. 9 fig, 17 ref.

Descriptors: *Borehole geophysics, *Monitoring wells, *Well logs, *Conductivity, *Aquifer testing, Water pollution control, Groundwater movement, Pumping tests, Groundwater management, Flow rates, Well seepage, Transmissivity, Geologic fractures, Water temperature, Electrical well logging, Geological surveys, Chemical properties, Potentiometric level, Well construction, Field tests.

Down-hole temperature and electrical-conductivity probes are attractive logging devices for use in monitoring wells, because they are readily available, relatively inexpensive, and allow for rapid measurements. Benefits of such logging are illustrated by examples from several small sites in complex hydrogeological settings. Interpretation of the logs provided information on the effectiveness of well purging, aquifer heterogeneities and the rates of ground water movement, leaks and cross-flows within wells, and locations of transmissive fractures in bedrock wells. Thus the logs offered an inexpensive means of acquiring valuable field information to supplement the geologic, potentiometric and chemical data collected during construction or subsequent investigation of the wells. (Author's abstract)
W89-12874

SCREENING OF GROUND WATER SAMPLES FOR VOLATILE ORGANIC COMPOUNDS USING A PORTABLE GAS CHROMATOGRAPH.
Geological Survey, Iowa City, IA.
For primary bibliographic entry see Field 5A.
W89-12876

HYDROPUNCH: AN IN SITU SAMPLING TOOL FOR COLLECTING GROUND WATER FROM UNCONSOLIDATED SEDIMENTS.
Weston (Roy F.), Inc., Albuquerque, NM.
R. W. Edge, and K. Cordry.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 3, p 177-183, 1989. 4 fig, 2 tab.

Descriptors: *Aquifer testing, *Unconsolidated aquifers, *Samplers, *Water sampling, *Sample preparation, Pollutant identification, Field tests, Vertical distribution, Pipes, Monitoring wells, Areal hydrogeology, Hydraulic equipment, In situ tests.

The Hydropunch is a stainless steel and Teflon sampling tool that is capable of collecting a representative ground water sample without requiring the installation of a ground water monitoring well. To collect a sample, the Hydropunch is connected to a small-diameter drive pipe and either driven or pushed hydraulically to the desired sampling depth. As the tool is advanced, it remains in the closed position, which prevents soil or water from entering the Hydropunch. Once the desired sampling depth is obtained, the tool is opened to the aquifer by pulling up the drive pipe approximately 1.5 feet (0.46 meters). In the open position, ground water can flow freely into the sample chamber of the tool. When the sample chamber is full, the Hydropunch is pulled to the surface. As the tool is retracted, check valves close and trap the ground water in the sample chamber. At the surface the sample is transferred from the Hydropunch to an appropriate sample container. The tool is a fast, inexpensive alternative for collecting ground water samples from a discrete interval. It is excellent for vertical profiling or defining the areal extent of a contaminant plume. (Author's abstract)
W89-12877

HYDRAULIC CONDUCTIVITY MEASUREMENTS IN THE UNSATURATED ZONE USING IMPROVED WELL ANALYSES.
Guelph Univ. (Ontario). Dept. of Land Resource Science.
D. E. Elrick, W. D. Reynolds, and K. A. Tan.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 3, p 184-193, 1989. 4 fig, 6 tab, 30 ref.

Descriptors: *Soil water, *Unsaturated flow, *Aeration zone, *Saturated flow, *Test wells, *Hydraulic conductivity, *Groundwater movement, On-site tests, Estimating, Permeameters.

The flow of ponded water into and through the unsaturated zone depends on both the saturated and unsaturated components of the hydraulic conductivity. recent studies indicate that the ratio of the saturated to the unsaturated components of flow lies within prescribed bounds for most field soils, i.e., the ratio lies between 1 and 100 per meter. In addition, the fact that the calculation of the saturated and unsaturated components of flow is not strongly dependent on the choice of their predicted ratio suggests that a site estimation of that ratio leads to reasonable 'best estimates' of the saturated and unsaturated components of flow when using the constant head well permeameter technique. As a consequence, measurement of the steady flow rate using only one ponded head may be all that is necessary for many practical applications. Multiple head measurements or independent measurements of the ratio or the unsaturated flow component can be used, however, to give more accurate estimates of the saturated flow component if required. (Author's abstract)
W89-12878

IN-HOUSE WELL DRILLING OPERATIONS FOR A GROUND WATER MONITORING PROGRAM, SUFFOLK COUNTY, NEW YORK.
Suffolk County Dept. of Health Services, Hauppauge, NY. Groundwater Resources Bureau.
For primary bibliographic entry see Field 7A.
W89-12879

USE OF TERRESTRIAL PHOTOGRAMMETRY AND REFLECTORLESS ELECTRONIC TELEMETRY (EDM) FOR EROSION MEASUREMENTS IN SMALL CATCHMENTS AND COMPARISON WITH MEASUREMENTS OF BED AND SUSPENDED LOADS OF THE BROOK (UTILISATION DE LA PHOTOGRAMMETRIE TERRESTRIE ET LA TELEMETRIE SANS REFLECTEUR POUR LA MESURE DE L'EROSION DE PETITS BASSINS-VERSANTS ET COMPARISON AVEC LES MESURES DE TRANSPORT SOLIDE A L'EMISSAIRE).
Institut Geographique National, Paris (France).
Y. Egels, M. Kasser, M. Meunier, T. Muxart, and C. Guet.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 183-187, 1989. 4 fig, 2 tab, 3 ref. English summary.

Descriptors: *Bed load, *Suspended load, *Slope degradation, *Geomorphology, *Small watersheds, *Photogrammetry, *Remote sensing, *Telemetry, *Erosion rates, Catchment areas, Marl, Electronic equipment, Terrain analysis, Volumetric analysis, France, Streams, Comparison studies.

Terrestrial photogrammetry and reflectorless electronic telemetry were tested for measurement of erosion in a first order catchment cut into marl bedrock at Draix (Southern Alps, France). These methods have been used to evaluate precisely (less than or equal to one centimeter) the amount of slope change by periodic survey without disturbing the environment. The mean annual volume of erosion has been estimated from these data and compared with measurements of bed and suspended loads of the stream. (Author's abstract)
W89-12880

MODELING OF BED LOAD SEDIMENT TRANSPORT FOR FLUVIAL FLOW (MODELISATION DU CHARRIAGE EN ECOULEMENT FLUVIAL).
For primary bibliographic entry see Field 2J.

W89-12892

DAMMING OF THE ANGARA RIVER AT THE SITE OF THE BOGUCHANY HYDROELECTRIC STATION.
For primary bibliographic entry see Field 8A.
W89-12899

CONSIDERATION OF THE ELASTOPLASTIC BEHAVIOR OF CONCRETE DAMS AND ROCK FOUNDATIONS IN CALCULATIONS WITH THE USE OF THE FINITE-ELEMENT METHOD.
For primary bibliographic entry see Field 8E.
W89-12904

ANALYSIS OF THE BEHAVIOR AND STRENGTHENING OF LOCK DOCK WALLS.
For primary bibliographic entry see Field 8A.
W89-12909

PREDICTION OF INVERTEBRATE COMMUNITIES USING STREAM MEASUREMENTS.
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 2H.
W89-12914

INEXPENSIVE VACUUM MANIFOLD FILTRATION SYSTEM.
Utah State Univ., Logan. Dept. of Biology.
L. C. Abbott, and J. W. Haefner.
Journal of Freshwater Ecology JFREDW, Vol. 5, No. 1, p 73-74, June 1989. 1 fig.

Descriptors: *Data acquisition, *Filtration, *Water sampling, *Sampling, *Limnology, Vacuum manifold filtration, Water analysis.

A vacuum manifold for filtration of water samples was assembled from a Rubbermaid Servin' Saver 32.5 cm diameter plastic cake keeper. The inside of the bowl-like part of the cake keeper was strengthened with a layer of fiberglass matting and resin. A Nalgene tapered tubing connecter was inserted into a hole drilled in the bowl and secured with silicone sealant. The tops of six Gelman Easy Pressure 25-mm syringe filter holders were enlarged to 1.6 cm. A 50-ml centrifuge tube with the bottom cut off was glued onto the upper portion of the filter holder. A piece of rubber tubing was attached to the outflow port of the syringe filter holder. Six holes were drilled into the lid and the outflow port of a filter holder was inserted in each one. The filter holder was then attached to the cake holder lid at both the outflow port and around the circumference of the filter holder using Elmer's Stix-All glue. An O-ring was inserted inside the removable upper half of the filter holder to ensure a watertight seal. (Cassar-PTT)
W89-12954

DETECTION OF EXOGENOUS GENE SEQUENCES IN DISSOLVED DNA FROM AQUATIC ENVIRONMENTS.
University of South Florida, St. Petersburg. Dept. of Marine Science.
M. F. DeFlaun, and J. H. Paul.
Microbial Ecology MCBEBU, Vol. 18, No. 1, p 21-28, 1989. 5 fig, 14 ref. NSF BSR8601570, EPA CR813589-02-0.

Descriptors: *Water analysis, *Limnology, *Rivers, *Aquatic environment, *Biological properties, *Genetics, DNA, Bacteria, Microbiological studies, Marine biology.

A method for the concentration and detection of gene sequences in the dissolved DNA from freshwater and marine environments was developed. The limit of detection in the dot blot format was 167 fg/ml (100 ml sample) for exogenous herpes simplex thymidine kinase gene that was added to artificial seawater or river water. This procedure was used to determine the longevity and to monitor progressive changes in molecular weight of a plasmid containing the thymidine kinase gene added to eutrophic estuarine water. The onset of plasmid degradation as determined by change in molecular weight was rapid, within 5 min. Intact plasmid was detected for at least 4 hr and sequences hybridizable to the thymidine kinase gene probe were present for up to 24 hours. (Author's abstract)
W89-12964

EFFECT OF UNEVEN SNOW COVER ON AIRBORNE SNOW WATER EQUIVALENT ESTIMATES OBTAINED BY MEASURING TERRESTRIAL GAMMA RADIATION.
Arizona State Univ., Tempe. Dept. of Decision and Information Systems.
S. S. Carroll, and T. R. Carroll.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1505-1510, July 1989. 2 fig, 1 tab, 14 ref.

Descriptors: *Remote sensing, *Snow water equivalent, *Snow cover, *Snowpack, *Mathematical analysis, *Error analysis, Gamma radiation, Snowmelt, Flood forecasting, Colorado, Canada.

Estimates of snow water equivalent derived from measurements of the attenuation of terrestrial gamma radiation are systemically biased downward if variability in the snow water equivalent exists in the snowpack. The degree of underestimation is a function of both the shape and the variance of the distribution. The effects of these two factors on the estimate of snow water equivalent were examined for three assumed distributions (discrete, normal, and uniform) over a wide range of variance of the distribution. The downward bias that results in each of the examined distributions can be corrected if the variance in the snow water equivalent is known. The methodology was applied to flight lines located in the plains of western Canada and in the mountainous region of Colorado. The methodology presented can aid National Weather Service hydrologists in improving river and flood forecasts, water supply forecasts, and spring flood outlooks for large areas of the United States and Canada. (Author's abstract)
W89-12977

IMPELLER METER FOR MEASURING AQUIFER PERMEABILITY VARIATIONS: EVALUATION AND COMPARISON WITH OTHER TESTS.
Auburn Univ., AL. Dept. of Civil Engineering.
F. J. Molz, R. H. Morin, A. E. Hess, J. G. Melville, and O. Guven.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1677-1683, July 1989. 16 fig, 38 ref. EPA contract CR13647010.

Descriptors: *Flowmeters, *Gages, *Aquifer testing, *Permeability, Hydraulic conductivity, Tracers, Well screens, Test wells, Pumping tests, Comparison studies, Field tests.

A knowledge of the variation of horizontal hydraulic conductivity with vertical position, K(z), is important in understanding the transport and dispersive properties of aquifers. Using an impeller meter to measure the discharge distribution in a screened well while pumping at a constant rate is a promising technique for obtaining the K(z) function. In such an application, the resulting K(z) functions were compared with those obtained previously using tracer tests and multilevel slug tests. Impeller meter data were the most convenient to obtain, and tracer data the most difficult. The K(z) between both borehole tests and the larger-scale tracer test showed that nonstationary hydraulic conductivity trends, in a stochastic hydrologic sense, exist in the test aquifer. The impeller meter method was better able to detect the higher K layers than was the multilevel slug approach. The results suggest that a practical strategy for 'fitting' impeller meter, tracer, or multilevel slug test data to a given aquifer is to use the selected testing procedure to obtain a dimensionless K/K distribution and then a standard pumping test to measure K. Combining both types of information permits dimensional values for K(z) to be calculated. In low permeability aquifers or near the bottom of a test well the fluid velocity due to pumping may be below the stall velocity of an impeller. Thus there is a definite need for the commercial development of more sensitive flow-measuring devices such as heat pulse flowmeters, which will extend the resolution of this field method. (Author's abstract)
W89-12993

OPTIMAL PUMPING TEST DESIGN FOR THE PARAMETER IDENTIFICATION OF GROUNDWATER SYSTEMS.
California Univ., Los Angeles. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W89-12999

MAPPING PESTICIDE CONTAMINATION POTENTIAL.
Hawaii Univ. at Manoa, Honolulu. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W89-13017

EROSION-BASED LAND CLASSIFICATION SYSTEM FOR MILITARY INSTALLATIONS.
Construction Engineering Research Lab. (Army), Champaign, IL.
For primary bibliographic entry see Field 2J.
W89-13018

METHODS FOR GROWTH INHIBITION TOXICITY TESTS WITH FRESHWATER ALGAE.
Vandkvalitetsinstitutet, Hoersholm (Denmark).
For primary bibliographic entry see Field 5A.
W89-13024

LOW FREQUENCY VARIABILITY IN THE LOWER ST. LAWRENCE ESTUARY.
Quebec Univ., Rimouski. Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W89-13036

APPLICATION OF ROBOTICS IN THE WATER INDUSTRY AND THE DEVELOPMENT OF A BOD ROBOT.
Southern Water Authority, Brighton (England).
For primary bibliographic entry see Field 2F.
W89-13070

NUMERICAL SIMULATION MODEL FOR PREDICTION OF BOD REMOVAL RATE IN STREAMS.
Tokyo Univ. (Japan). Inst. of Industrial Science.
For primary bibliographic entry see Field 5B.
W89-13076

QUANTIFICATION OF COENZYME F420 ANALOGUES FROM METHANOGENIC BACTERIA BY HPLC AND FLUORIMETRY.
Katholieke Univ. Nijmegen (Netherlands). Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W89-13110

EVALUATION OF THE CIC MODEL OF 210PB DATING OF SEDIMENTS.
McMaster Univ., Hamilton (Ontario). Dept. of Materials Science and Engineering.
B. S. Shukla, and S. R. Joshi.
Environmental Geology and Water Sciences EGWSEI, Vol. 14, No. 1, p 73-76, July-August 1989. 1 tab, 7 ref.

Descriptors: *Radioactive dating, *Lead radioisotopes, *Cores, *Lake sediments, *Paleolimnology, Isotope studies, Mathematical models, Dating, Polynomial regression, Regression analysis, Sediment compaction, Performance evaluation.

Linear and polynomial regression analysis techniques were used to assess the constant initial concentration (CIC) model of 210Pb dating. Results obtained using published 210Pb and porosity profiles in 12 freshwater sediment cores show that linear regression affords more reliable results. The

polynomial regression, while capable of predicting the values of the constant beta or beta' derived from porosity data, gives reasonable results only when the coefficients of the polynomial are of the appropriate sign. Lower values for all the parameters are obtained in all cases if the effect of compaction is not considered. (Author's abstract)
W89-13116

MULTIPLE TESTING APPROACH FOR HAZARD EVALUATION OF COMPLEX MIXTURES IN THE AQUATIC ENVIRONMENT: THE USE OF DIESEL OIL AS A MODEL.
National Fisheries Contaminant Research Center, Columbia, MO.
For primary bibliographic entry see Field 5A.
W89-13156

AUTOMATED CALIBRATION OF A CONTAMINANT TRANSPORT MODEL FOR A SHALLOW SAND AQUIFER.
Interstate Commission on the Potomac River Basin, Rockville, MD.
For primary bibliographic entry see Field 5B.
W89-13164

ELECTRICAL RESISTIVITY OF THE VADOSE ZONE--FIELD SURVEY.
Rhode Island Univ., Kingston. Dept. of Geology.
R. K. Frohlich, and C. D. Parke.
Ground Water GRWAAP, Vol. 27, No. 4, p 524-530, July-August, 1989. 6 fig, 2 tab, 15 ref. NSF Grant No. ENG 7819408.

Descriptors: *Path of pollutants, *Geophysical methods, *Borehole geophysics, *Vadose zone, *Resistivity, *Interstitial water, *Geohydrology, Conductivity , Particle size.

An expansion of Archie's law relates the electrical resistivity of the unsaturated zone to pore-water resistivity, porosity, saturation, electrical matrix conductivity, and lithological constants. With decreasing saturation the effect of the matrix conductivity increases relative to the electrical conduction of the pore fluid. The bulk electrical resistivity depends on water quality and quantity due to its dependence on pore-water resistivity and porosity. It is also influenced by the hydraulic conductivity due to the surface conductivity of the grain matrix, which is proportional to grain size. Pore-water conductivity and grain-surface conductivity can be distinguished from each other if resistivity measurements at various degrees of saturation are available. Observation in test wells through glacial stream deposits with a neutron moisture probe show, as expected, a decrease in saturation of the vadose zone during the transition from late spring to the dry summer season. This decrease was correlated with the transverse resistance of the unsaturated zone derived from an interpretation of geoelectrical depth soundings near the test wells. In the fine to medium sand of the glacial outwash material, the surface conduction of the grains was found to be negligibly small. (Author's abstract)
W89-13167

APPLICATION AND COMPARISON OF SHALLOW SEISMIC METHODS IN THE STUDY OF AN ALLUVIAL AQUIFER.
Nebraska Univ., Lincoln. Conservation and Survey Div.
J. F. Ayers.
Ground Water GRWAAP, Vol. 27, No. 4, p 550-563, July-August, 1989. 13 fig, 1 tab, 23 ref.

Descriptors: *Seismic exploration, *Geophysical methods, *Data acquisition, *Geohydrology, *Seismology, *Alluvial aquifers, Bedrock, Platte River, Nebraska, Flood plains.

Seismic refraction, common-offset, and common-depth-point methods were applied to an area on the flood-plain of the Platte River in east-central Nebraska to map the configuration of the bedrock surface, determine the thickness of the alluvial overburden, and define the hydrostratigraphy of the aquifer. Refraction results indicate a complex channelized bedrock surface that ranges in depth from 15 m to 40 m. At most stations, seismic velocities determined for the bedrock could be used to distinguish between rocks of the Dakota Group and Pennsylvanian-age limestones and shales. Bedrock is overlain by alluvium with velocities typical of saturated sediments. A near-surface clay unit was identified at a few refraction stations. Seismic velocities measured for the saturated sediments were used, in conjunction with an empirical relationship between velocity and bulk density, to obtain an estimate of 0.25 to 0.43 for the bulk porosity of the aquifer. A comparison of survey results shows that depths to bedrock obtained from the three methods are in good agreement where coincident measurements were made. The comparison also shows that the relief along the bedrock surface is defined in greater detail using reflection techniques, particularly the common-depth-point method. The shallow limit of investigation for the common-offset method, at least for the field conditions present in the lower Platte Valley, is about 15 m, or one-half of the limit previously considered by other workers. (Author's abstract)
W89-13170

EVALUATION OF THE MEASUREMENTS OF EXTRACELLULAR ENZYME ACTIVITIES IN A POLYHUMIC LAKE BY MEANS OF STUDIES WITH 4-METHYUMBELLIFERYL-SUBSTRATES.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie.
For primary bibliographic entry see Field 2H.
W89-13173

ORGANIC MATTER DEGRADATION AND NUTRIENT REGENERATION IN AUSTRALIAN FRESHWATERS: I. METHODS FOR EXOENZYME ASSAYS IN TURBID AQUATIC ENVIRONMENTS.
Murray-Darling Freshwater Research Centre, Albury (Australia).
P. I. Boon.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 3, p 339-359, May 1989. 9 fig, 4 tab, 44 ref.

Descriptors: *Cycling nutrients, *Limnology, *Enzymes, *Biodegradation, *Assay, *Laboratory methods, Turbidity, Hydrogen ion concentration, Temperature effects, Lagoons, Rivers, Billabongs, Australia.

A method was developed using p-nitrophenol and p-nitroaniline derivatives to measure exoenzyme activity in turbid waters, as an indicator of biodegradation. Maximum activity occurred at or above 40 C. The response to variations in pH was complex, with some systems showing no clear optimum but others showing an optimum at either pH 7.5 or pH 9.0-10. Only 25% of the enzyme system-site combinations generated linear Line-weaver-Burke plots, indicating that many exoenzyme systems were active simultaneously in the degradation of organic detritus. The maximum rate of activity occurred with aminopeptidase (up to 107 micromol/L/d), followed by alkaline phosphatase (up to 42 micromol/L/d). There was little lipase or alpha-D glucosidase activity in the any water body, except in a highly-eutrophied lagoon. Rates were consistently higher in billabongs than in rivers, and most activity was associated with particles rather than being free in the water column. (Author's abstract)
W89-13174

ADSORPTION OF THREE AMINO ACIDS TO BIOFILMS ON GLASS-BEADS.
Mount Allison Univ., Sackville (New Brunswick). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-13176

EROSION AND INFILL OF NEW YORK FINGER LAKES: IMPLICATIONS FOR LAURENTIDE ICE SHEET DEGLACIATION.
Syracuse Univ., NY. Dept. of Geology.
For primary bibliographic entry see Field 2H.
W89-13184

PROTECTION OF GROUND-WATER MONITORING WELLS AGAINST FROST HEAVE.
Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD. Waste Disposal Engineering Div.
W. C. B. Gates.
Bulletin of the Association of Engineering Geologists, AEGBBU, Vol. 26, No. 2, p 241-251, 1989. 8 fig, 4 tab, 34 ref.

Descriptors: *Monitoring wells, *Frost heaving, *Frost protection, *Grouting, *Concretes, Bentonite, Soil properties, Groundwater pollution, Well design, Wells, Design standards.

Frost heave damage to grout seals around groundwater monitoring wells can present severe environmental as well as expensive remedial problems. Protection of the grout integrity around the monitoring wells is of paramount importance. Predisposing conditions which promote frost heave include the following: (1) Depth and duration of frost penetration affect the degree of frost activity; (2) The soils must be susceptible to frost action, primarily clayey fine sands and silts; and (3) There must be a source of moisture close enough to supply capillary water to the frost line. When these conditions are right, monitoring wells, grouted with concrete, can be subject to damage from frost heave. Frost damage has been observed around wells installed in the northern tier States and mountainous areas. The damage noted was crumbling, shearing and separation of the concrete apron and annular seal around the well casing. The steel protective casings and sometimes the wells themselves were dislodged vertically, destroying the integrity of the well which promoted influent drainage of potentially contaminated runoff to the groundwater. The standard well design works well under conditions not subject to frost heave. However, the concrete apron which mantles the ground surface and forms a pile around the casing is the focal point of the full force of the heaving soil. To prevent frost heave damage of monitoring wells, it is recommended that concrete aprons be abandoned in frost susceptible areas. As an alternative to the traditional concrete mixtures, bentonite has proved successful as a grout seal around monitoring wells. (Peters-PTT)
W89-13197

MEASUREMENT AND CONTROL.
For primary bibliographic entry see Field 5F.
W89-13213

USE OF REMOTE SENSING TECHNIQUES TO ENHANCE IN SITU WATER QUALITY MONITORING.
Army Engineer District, Rock Island, IL. Water Quality and Sedimentation Section.
D. P. Bierl.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 17-31, 5 fig, 10 ref.

Descriptors: *Remote sensing, *Monitoring, *Water quality control, *Dissolved oxygen, *Measuring instruments, Water sampling, Data interpretation, Water quality.

A 5-year study called the Remote Sensing Demonstration Program for Inland Waterways is currently in progress (FY 86 to FY 90), to: (1) demonstrate the use of aerial and satellite images in water resources activities, including comparison of the reliability, information content, and cost of acquiring and analyzing such data, and (2) demonstrate the use of state-of-the-art environmental and hydrometeorological sensors which telemeter data via Geostationary Operational Environmental Satellite and other data relay systems. Engineering and operations application areas involve the use of in situ sensors to measure numerous hydrological, geological and meteorological parameters, and include water quality sensors for the following: pH, dissolved oxygen, temperature, conductivity, ammonia and nitrate. The accomplishments to date, particularly the descriptions of, and preliminary results from, the testing of three dissolved oxygen (DO) probes, are presented. (1) The Leeds and

Northrup (LN) DO probe was tested in the laboratory by Rock Island District personnel from March 18, 1987, through April 8, 1987, to determine how DO concentrations determined with the LN meter compared with those determined by the azide modification of the Winkler method. The probe was air calibrated and placed in a tank containing Mississippi River and water. Although the Winkler values/LN values were close, the LN values were often lower than those determined by the Winkler method. In addition, the LN probe cannot be air calibrated when ambient air temperatures are below freezing. (2) The Zullig DO sensor was positioned and calibrated in a manner similar to the Leeds and Northrup probe. Studies indicated that the average difference between the Zullig values and Winkler values was only 0.08 mg/L. However, the Zullig sensor is limited in that a minimum solution conductivity of 300 microohms/cm is required for proper sensor operation. Also, the manufacturer suggests not using the sensor in waters with a pH below 6.5. (3) The Royce DO sensor was placed in a tank containing Mississippi River water and air calibrated. Results indicate that the Royce sensor appeared to be quite sensitive to flow, with average values varying an average of 0.21-1.32 mg/L from the Winkler values. (See also W89-13231) (Lantz-PTT)
W89-13234

USE OF SPOT HRV DATA IN THE CORPS OF ENGINEERS DREDGING PROGRAM.
Cold Regions Research and Engineering Lab., Hanover, NH.
C. J. Merry, H. L. McKim, N. LaPotin, and J. R. Adams.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 335-349, 10 fig, 4 tab, 10 ref.

Descriptors: *Spoil banks, *Remote sensing, *Dredging, *Waste disposal, Satellite technology, Navigation channels, Coastal waters, Data acquisition.

The Corps of Engineers must keep navigation channels open in nearshore and estuarine environments by dredging these channels and maintaining them, in many cases at a minimum channel depth of 35 to 40 ft. In areas where the impact of unconfined disposal of dredged material must be monitored, the cost of site selection and subsequent water quality monitoring can become very high. It is important in these instances to select representative water quality sampling locations, but it is equally important to minimize the number of water quality samples required. With this in mind, a study was done to: (1) review the application of existing remote sensing techniques for providing data in the Corps' dredging program; (2) define promising new remote sensing techniques for monitoring and managing dredged disposal sites; and (3) recommend which remote sensing techniques should be used now and which techniques should be developed for the future. Additional research is required to study the use of multispectral scanners for bathymetric mapping of large coastal areas, for mapping sediment transport in shallow waters, for mapping concentrations of suspended matter of organic or inorganic origin, and for detecting vegetative stress and soil properties. Along with acquiring multispectral data, ground truth needs to be taken to verify the interpretation of the data. The spatial resolution and time frequency of data acquisition are important when evaluating remote sensing techniques for use in the dredging program. The French Systme Probatoire d'Observation de la Terre (SPOT) satellite system is the first operational system that will allow data acquisition and distribution in a short time frame (< 48 hrs). The results from the study indicate that the 20-m multispectral data from the SPOT satellite is useful for differentiating between relative suspended sediment levels at dredged disposal areas. Around the immediate dredged disposal area, very little variation was seen in the water quality sampling data. The sparsely sampled ground truth data and the 2-mg/L measurement accuracy did not warrant a complete statistical analysis of the digital image data. The first model showed a nonlinear association between suspended sediment concentration and turbidity. (See also W89-13231) (Lantz-PTT)
W89-13263

GUIDE STANDARD AND PROTOCOL FOR TESTING MICROBIOLOGICAL WATER PURIFIERS.
Army Biomedical Research and Development Lab., Fort Detrick, MD.
For primary bibliographic entry see Field 5F.
W89-13280

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN MARYLAND, DELAWARE, AND THE DISTRICT OF COLUMBIA.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-13328

OPERATING MANUAL FOR THE U.S. GEOLOGICAL SURVEY MINIMONITOR, 1988 REVISED EDITION, PUNCHED-PAPER-TAPE MODEL.
Geological Survey, Stennis Space Center, MS. Water Resources Div.
J. H. Ficken, and C. T. Scott.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $12.50, microfiche $4.00. USGS Open-File Report 88-491, 1989. 76p, 29 fig, 7 tab, 6 ref, append.

Descriptors: *Instrumentation, *Data acquisition, *Water quality, *Monitoring, Data collections.

This manual describes the U.S. Geological Survey Minimonitor Water Quality Data Measuring and Recording System. Instructions for calibrating, servicing, maintaining, and operating the system are provided. The Survey Minimonitor is a battery-powered, multiparameter water quality monitoring instrument designed for field use. A watertight can containing signal conditioners is connected with cable and waterproof connectors to various water quality sensors. Data are recorded on a punched paper-tape recorder. An external battery is required. The operation and maintenance of various sensors and signal conditioners are discussed, for temperature, specific conductance, dissolved oxygen, and pH. Calibration instructions are provided for each parameter, along with maintenance instructions. Sections of the report explain how to connect the Minimonitor to measure direct-current voltages, such as signal outputs from other instruments. Instructions for connecting a satellite data-collection platform or a solid-state data recorder to the Minimonitor are given also. Basic information is given for servicing the Minimonitor and troubleshooting some of its electronic components. The use of test boxes to test sensors, isolate component problems, and verify calibration values is discussed. (USGS)
W89-13333

CONSTRUCTION, GEOLOGIC, AND GROUNDWATER DATA FOR OBSERVATION WELLS NEAR THE SHELBY COUNTY LANDFILL, MEMPHIS, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-13335

METHODS FOR ESTIMATING MONTHLY STREAMFLOW CHARACTERISTICS AT UNGAGED SITES IN WESTERN MONTANA.
Geological Survey, Helena, MT. Water Resources Div.
C. Parrett, and K. D. Cartier.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-40, May 1989. 59p, 8 fig, 13 tab, 23 ref.

Descriptors: *Streamflow, *Channel morphology, *Discharge measurement, *Montana, Low flow.

Three methods were developed for estimating monthly streamflow characteristics for western Montana. The first method, based on multiple-regression equations, relates monthly streamflow characteristics to various basin and climatic variables. Standard errors range from 43 to 107%. The equations are generally not applicable to streams that receive or lose water as a result of geology or that have appreciable upstream storage or diversions. The second method, based on regression equations, relates monthly streamflow characteristics to channel width. Standard errors range from 41 to 111%. The equations are generally not applicable to streams with exposed bedrock, with braided or sand channel, or with recent alterations. The third method requires 12 once-monthly streamflow measurements at an ungaged site. They are then correlated with concurrent flows at some nearby gaged site, and the resulting relation is used to estimate the required monthly streamflow characteristic at the ungaged site. Standard errors range from 19 to 92%. Although generally substantially more reliable than the first or second method, this method may be unreliable if the measurement site and the gage site are not hydrologically similar. A procedure for weighting individual estimates, based on variance and degree of independence of individual estimating methods, was also developed. Standard errors range from 15 to 43% when all three methods are used. The weighted-average estimated from all three methods are generally substantially more reliable than any of the individual estimates. (USGS)
W89-13343

USE OF SURFACE-GEOPHYSICAL METHODS TO ASSESS RIVERBED SCOUR AT BRIDGE PIERS.
Geological Survey, Hartford, CT. Water Resources Div.
S. R. Gorin, and F. P. Haeni.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4212, 1989. 39p, 16 fig, 1 tab, 19 ref.

Descriptors: *Instrumentation, *Radar, *Surface geophysics, *Scour, *Geophysics, Bridge piers, Seismic systems, Ground-penetrating radar, Fluvial sediments, Connecticut River, River beds, Bridges, Sonar.

A ground-penetrating-radar system, and three seismic systems--color fathometer, tuned transducer, and black-and-white fathometer--were used to evaluate river-bed scour at the Charter Oak, Founder's and Bulkeley Bridges in Hartford, Connecticut. Cross-sections of the channel and some lateral sections were run at each bridge in June and July 1987, and significant scour at piers supporting each of these bridges was recorded. Each of the four geophysical systems proved to have advantages and limitations. The ground penetrating radar system used single and dual 80 megahertz antennae floating in the water to transmit and receive the signal. The method was successful in water less than 25 ft deep, and in resistive earth materials. The geometry of existing scour holes and the extent of post-scour sedimentation were clearly defined. The color fathometer, operating at a signal frequency of 20 kilohertz, delineated existing scour-hole geometry, detected infilling of scour holes, and provided qualitative information about the physical properties of sediments. The tuned transducer, operating at a signal frequency of 14 kilohertz, defined scour-hole geometry and the extent of post-scour sediment deposition. Both of these systems were effective in water greater than 5 ft deep. At a signal frequency of 200 kilohertz, the black-and-white fathometer could not penetrate post-scour deposits, but it was useful in defining existing scour-holed geometry in water of any depth. (USGS)
W89-13344

OPERATING MANUAL FOR THE R200 DOWNHOLE RECORDER WITH TANDY 102 RETRIEVER.
Geological Survey, Stennis Space Center, MS. Water Resources Div.
R. A. Johnson, and J. I. Rorabaugh.
Available from Books and Open File Report Sec-

tion, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-488, Jan 1989. 113p, 10 fig.

Descriptors: *Measuring instruments, *Instrumentation, *Water level, *Electronic recorders, *Water level recorders, Groundwater, Pressure transducer, Wells.

The R200 Downhole Recorder is a battery-powered device that, when placed in a well casing, monitors water levels for a period of up to 1 year. This instrument measures a 1- to 70-ft range of water levels. These water level data can be retrieved through use of a commercially available portable microcomputer. The R200 Downhole Recorder was developed at the U. S. Geological Survey's Hydrologic Instrumentation Facility, Stennis Space Center, Mississippi. This operating manual describes the R200 Downhole Recorder, provides initial set-up instructions, and gives directions for on-site operation. Design specifications and routine maintenance steps are included. The R200 data-retriever program is a user-friendly, menu-driven program. The manual guides the user through the procedures required to perform specific operations. Numerous screens are reproduced in the text with a discussion of user input for desired responses. Help is provided for specific problems. (USGS)
W89-13346

USE OF AEROMAGNETIC DATA TO DEFINE BOUNDARIES OF A CARBONATE-ROCK AQUIFER IN EAST-CENTRAL NEVADA.
Geological Survey, Carson City, NV.
For primary bibliographic entry see Field 2F.
W89-13362

TEST WELL SF-1A, 1B, 1C, AND SF-2A, 2B, 2C, SANTA FE COUNTY, NEW MEXICO.
Geological Survey, Albuquerque, NM. Water Resources Div.
D. L. Hart.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-37, May 1989. 24p, 6 fig, 4 tab, 2 ref.

Descriptors: *Water resources data, *Groundwater movement, *Hydrologic data, *Groundwater, *Piezometers, *Santa Fe County, *New Mexico, *Observation wells, Water quality.

Two well nests, SF-1 and SF-2, were drilled in Santa Fe County, New Mexico, to monitor the hydraulic head within selected zones of the aquifer. Each well nest consists of three piezometers of shallow, middle, and deep completion within the aquifer. Each set of wells was drilled to a depth of about 2,000 ft before actual construction of the piezometers. Each piezometer was completed using either 5 or 10 ft of wire-wrapped screen. These piezometers were constructed as part of a larger ongoing program with the Santa Fe Metropolitan Water Board and New Mexico State Engineer Office to establish a regional observation-well network and to define better the groundwater flow system in the vicinity of Santa Fe and Santa Fe well fields. (USGS)
W89-13369

MEASUREMENTS OF RECHARGE RATES THROUGH AN UNSATURATED GLACIAL TILL BY TRITIUM ANALYSES.
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 2F.
W89-13381

USE OF GROUND PENETRATING RADAR TO DEFINE RECHARGE AREAS IN THE CENTRAL SAND PLAIN.
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2F.
W89-13382

EVALUATION OF METHODS FOR THE ESTIMATION OF TRIBUTARY MASS LOADING RATES.
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W89-13405

7C. Evaluation, Processing and Publication

EXPERIMENTAL STUDIES OF MASS TRANSPORT IN POROUS MEDIA WITH LOCAL HETEROGENEITIES.
Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.
For primary bibliographic entry see Field 5B.
W89-12190

FINITE ELEMENT ANALYSIS OF CONTROLLED SALTWATER INTRUSION IN HETEROGENEOUS RESERVOIRS.
Tage Sorensen, Consulting Engineers Ltd.
For primary bibliographic entry see Field 2F.
W89-12196

NEW FORM OF WATER QUALITY INDEX FOR RIVERS AND STREAMS.
Department of Scientific and Industrial Research, Hamilton (New Zealand). Water Quality Centre.
D. G. Smith.
Water Science and Technology WSTED4, Vol. 21, No. 2, p 123-127, 1989. 3 fig, 2 tab, 5 ref.

Descriptors: *Water quality standards, *Data interpretation, *New Zealand, Rivers, Streams.

To assist in the dissemination of water quality information to lay-people in particular, four suitability-for-use water quality indexes were developed. The water uses are: General, Bathing, Supply, and Fish Spawning although in the Bathing and Supply Indexes protection of aquatic life is also considered. To ensure that they tell something useful and do not hide important information as current indexing systems tend to do, the Minimum Operator was employed as the sub-index aggregation mechanism. This is a robust, sensible, and flexible method and seems more appropriate for this type of index than the more commonly used techniques (e.g. additive and multiplicative). Index development has been keyed into proposed New Zealand water legislation although this is not a pre-requisite for their use. (Author's abstract)
W89-12220

ADVANCING COMPUTERIZED PLANNING FOR WASTEWATER COLLECTION.
Camp, Dresser and McKee, Inc., Walnut Creek, CA.
For primary bibliographic entry see Field 5D.
W89-12246

STATISTICAL ANALYSIS OF THE HYDROMETEOROLOGICAL ELEMENTS AND THEIR EFFECT ON THE SALINITY, BIOGENIC MATTER AND PRIMARY PRODUCTION OF ORGANIC MATTER IN THE SEA OF AZOV (STATICHESKII ANALIZ VLIIANIIA GIDROMETEOROLOGICHESIKH ELEMENTOV NA SOLENOST' BIOGENNYE VESHCTESTVA I PERVICHNUIU PRODUKTSIIU V AZOVSKOM MORE).
Azovskii Nauchno-Issledovatel'skii Inst. Rybnogo Khozyaistva, Rostov-na-Donu (USSR).
For primary bibliographic entry see Field 2L.
W89-12276

MODEL FOR THE ESTIMATION OF CONVECTIVE EXCHANGE IN THE LITTORAL REGION OF A SHALLOW LAKE DURING COOLING.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 2H.
W89-12306

MEASUREMENT AND MODELING OF RAINFALL INTERCEPTION BY AMAZONIAN RAIN FOREST.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2B.
W89-12332

ESTIMATION OF SOIL MOISTURE DEFICITS USING METEOROLOGICAL MODELS AT AN UPLAND MOORLAND SITE IN NORTHERN ENGLAND.
Leeds Univ. (England). School of Geography.
For primary bibliographic entry see Field 2G.
W89-12344

DEVELOPMENT AND MONTE CARLO ANALYSIS OF AN OYSTER BIOACCUMULATION MODEL APPLIED TO BIOMONITORING DATA.
Versar, Inc., Columbia, MD.
For primary bibliographic entry see Field 5B.
W89-12371

TOWARD A MODEL FOR OPEN-BASIN AND CLOSED-BASIN DEPOSITION IN ANCIENT LACUSTRINE SEQUENCES: THE NEWARK SUPERGROUP (TRIASSIC-JURASSIC), EASTERN NORTH AMERICA.
Emory Univ., Atlanta, GA. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W89-12375

NEW PLOTTING-POSITION FORMULA FOR PEARSON TYPE-III DISTRIBUTION.
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-12411

MODELING MIXED SEDIMENT SUSPENDED LOAD PROFILES.
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-12414

AVAILABLE WATER-HOLDING CAPACITY MAPS OF ALBERTA, SASKATCHEWAN AND MANITOBA.
Agriculture Canada, Ottawa (Ontario). Land Resource Research Centre.
For primary bibliographic entry see Field 2G.
W89-12435

EVALUATION OF THE STABILITY OF A CHANNEL WITH PARTIAL REVETMENT.
For primary bibliographic entry see Field 4D.
W89-12466

EVALUATION OF SURFACE AND FILM DIFFUSION COEFFICIENTS FOR CARBON ADSORPTION.
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-12478

ANALYSIS OF DISINFECTION DATA FROM DILUTION COUNT EXPERIMENTS.
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5F.
W89-12488

PRINCIPAL COMPONENT ANALYSIS: A CHEMOMETRIC AID FOR CLASSIFICATION OF POLLUTED AND UNPOLLUTED MUSSELS.
Trieste Univ. (Italy). Dipt. di Economia e Merceologia delle Risorse Naturali e della Produzione.
For primary bibliographic entry see Field 5A.
W89-12601

MODELING SOLUTE TRANSPORT BY CENTRIFUGATION.
CH2M Hill, Inc., Corvallis, OR.
For primary bibliographic entry see Field 5B.
W89-12615

MATHEMATICAL INTERPRETATION OF AQUEOUS-PHASE OZONE DECOMPOSITION RATES.
Connecticut Univ., Storrs. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-12616

TIME SERIES ANALYSIS OF WATER QUALITY DATA IN PEARL RIVER, CHINA.
Hong Kong Univ. Dept. of Civil Engineering.
A. W. Jayawardena, and F. Lai.
Journal of Environmental Engineering (ASCE) JOEEDR, Vol. 115, No. 3, p 590-607, June 1989. 6 fig, 7 tab, 19 ref.

Descriptors: *Time series analysis, *Water quality, *Data collections, *China, *Stochastic process, *Model studies, Probabilistic process, Data processing, Pearl River.

A time series analysis approach was applied to model 21 years of mean monthly water quality data in the Yuancun and Fangcun sections of the Guangzhou reach of the Pearl River in southern China. The basic properties of the water quality data time series were determined, time-domain and frequency-domain analyses were carried out, and the dependent stochastic component was represented by various stochastic models. Synthetic water quality data were generated by using the probability distribution of the independent residuals, and forecasting of future water quality data was done using a Box-Jenkins-type difference model. Eighteen years of data were used for model development, while the model performance was compared with the data for the remaining three years. The comparisons were found to be satisfactory. Three of the four data series were adequately described by low-order ARMA models (p, q < or = 2). But for the Fangcun data, the residual series showed strong dependence even after fitting an ARMA(2,2) model. A higher order model, ARMA(5,8), was therefore used for this data series. The strong dependence of the residual series for low-order ARMA models for this series may imply that there are still some deterministic elements remaining in the series even after removing trend and periodicity by the methods described. (Author's abstract)
W89-12618

MODELING SODIUM AND CHLORIDE IN SURFACE STREAMS DURING BASE FLOWS.
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
I. Runge, R. M. Wright, and D. W. Urish.
Journal of Environmental Engineering (ASCE) JOEEDR, Vol. 115, No. 3, p 608-619, June 1989. 7 fig, 4 tab, 27 ref.

Descriptors: *Model studies, *Path of pollutants, *Groundwater pollution, *Surface-groundwater relations, *Sodium, *Chlorides, *Water pollution sources, *Roads, Effluents, Watersheds, Catchment areas, Deicers, Base flow.

Sodium and chloride contaminants of shallow groundwater can be frequently attributed to three major sources: (1) individual sewage disposal systems (ISDS); (2) road salt application during winter deicing activities; and /or (3) road salt storage. Effluent streams in a large reservoir watershed were sampled during baseflow conditions. Sodium and chloride concentrations were regressed against different land use types including roadway, residential commercial, industrial, agricultural, and forest areas. Results indicate that roadway areas are the largest single influence of sodium and chloride concentrations. Data from other watersheds are compared to the developed relationships and agreement is favorable. Additionally, a mass balance is performed and indicates that, typically, roadway deicing activity in the test watershed can potentially introduce far greater amounts of sodium and chloride in the local groundwater than the next greatest influence, residential septic systems. (Author's abstract)
W89-12619

STATISTICS-BASED APPROACH TO WASTEWATER TREATMENT PLANT OPERATIONS.
Wisconsin Univ., Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W89-12622

POST-AUDIT STUDY OF DIELDRIN BIOCONCENTRATION MODEL.
Missouri Univ.-Columbia. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-12623

USE OF STOCHASTIC HYDROLOGY IN RESERVOIR OPERATION.
Bureau of Reclamation, Denver, CO. Surface Water Branch.
For primary bibliographic entry see Field 2H.
W89-12630

SIMULATION MODELS OF SEQUENCES OF DRY AND WET DAYS.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 2B.
W89-12631

STOCHASTIC APPROXIMATION APPLIED TO OPTIMAL IRRIGATION AND DRAINAGE PLANNING.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W89-12641

SEASONALITY OF NUTRIENT REGENERATION IN AN ORGANIC-RICH COASTAL SEDIMENT: KINETIC MODELING OF CHANGING PORE-WATER NUTRIENT AND SULFATE DISTRIBUTIONS.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 2L.
W89-12704

MODELLING PHOTOSYNTHESIS AND OXYGEN IN A SHALLOW, HYPERTROPHIC LAKE.
Agricultural Univ., Wageningen (Netherlands).
For primary bibliographic entry see Field 2H.
W89-12772

SEDIMENT TRANSPORT MODELLING OF ALLUVIAL RIVERS: AN ACTION OF A NATIONAL NATURE (LA MODELISATION DU TRANSPORT SOLIDE EN RIVIERE: UNE ACTION CARACTERE NATIONAL).
For primary bibliographic entry see Field 2J.
W89-12890

ALLUVIAL RIVER MODELLING: BED LOAD, GRAIN SORTING AND ARMOURING (MODELES D'EVOLUTION DE LITS ALLUVIONIVAIRES SOUMIS A CHARRIAGE: TRI GRANULOMETRIQUE ET PAVAGE).
Societe Grenobloise d'Etudes et d'Applications Hydrauliques (France).
For primary bibliographic entry see Field 2J.
W89-12891

COMPUTATION OF THE VOLUME OF MUD ERODED IN RESERVOIRS BY FLOODS (SIMULATION NUMERIQUE DE L'EROSION DES VASES DE RETENUE PAR LE CRUES).
For primary bibliographic entry see Field 2J.
W89-12893

MACROPHYTE SUBMODEL FOR AQUATIC ECOSYSTEMS.
New York State Museum, Albany.
For primary bibliographic entry see Field 2H.
W89-12929

UPDATING RANDOM HYDRAULIC CONDUCTIVITY FIELDS: A TWO-STEP PROCEDURE.
Michigan Technological Univ., Houghton. Dept. of Geology and Geological Engineering.
For primary bibliographic entry see Field 2F.
W89-13002

TWO DIMENSIONAL NUMERICAL MODELING OF HYDRODYNAMICS AND POLLUTANT TRANSPORT IN A WET DETENTION POND.
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-13050

APPLICATION OF EXPERT SYSTEMS TECHNOLOGY IN WATER QUALITY MODELING.
Environmental Protection Agency, Athens, GA.
T. O. Barnwell, L. C. Brown, and W. Marek.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 1045-1056, 1989. 8 fig, 19 ref.

Descriptors: *Computer models, *Water pollution control, *Water quality, *Model studies, *Computers, *Expert systems, Streams, Technology, Decision making, Environmental engineering.

Computerized modeling is becoming an integral part of decision-making in water pollution control. Expert systems is an innovative methodology that can assist in building, using, and interpreting the output of these models. The use of these systems is reviewed and the potential of expert systems technology in environmental modeling is evaluated. Elements of an expert advisor for the stream water quality model QUAL2E is described. Some general conclusions are presented about the tools available to develop this system, the level of available technology in knowledge-based engineering, and the value of approaching problems from a knowledge engineering perspective. Clearly, the application of expert systems technology offers several benefits to environmental modeling. The process of knowledge engineering (the applied side of expert systems) will improve the modeling process by producing a different perspective on modeling and by improving man-machine interaction. The most significant benefit, however, is that expert systems will increase the level of sophistication and proficiency of the average model user. This is done through the extension of the user's knowledge (although it may be assumed that at least some users, realizing the importance of performance, may become more involved in the modeling process), but by providing users with a better tool that is an extension of QUAL2E. A significant benefit to be gained from the application of this technology to the model developer is a better understanding of the model itself. By approaching the application of the model from the perspective of the knowledge engineer, considerable insight into the model is gained and the codification of rules for application of the model reveals many subtle linkages between inputs that may not be obvious. (Miller-PTT)
W89-13080

EVALUATION OF HEURISTIC PROGRAM FOR SCHEDULING TREATMENT PLANT PUMPS.
Centre d'Enseignement et de Recherche pour la Gestion des Ressources Naturelles et l'Environnement, Paris (France).
For primary bibliographic entry see Field 5F.
W89-13126

MINIMIZATION OF RAW WATER PUMPING COSTS USING MILP.
Research Triangle Inst., Research Triangle Park, NC.
For primary bibliographic entry see Field 5F.
W89-13130

HORIZONTAL ANISOTROPY OF THE PRINCIPAL GROUND-WATER FLOW ZONE IN THE SALINAS ALLUVIAL FAN, PUERTO RICO.
Geological Survey, San Juan, PR.
For primary bibliographic entry see Field 2F.
W89-13163

COMPUTING WELL HYDRAULICS SOLUTIONS.
California Univ., Irvine. Dept. of Civil Engineering.
D. E. Dougherty.
Ground Water GRWAAP, Vol. 27, No. 4, p 564-569, July-August, 1989. 2 fig, 1 tab, 9 ref.

Descriptors: *Type curves, *Theis equation, *Groundwater movement, *Computer programs, *Well hydraulics, *Drawdown, Fortran, Laplace equation, Groundwater.

Type curves, and drawdown analysis curves of other sorts, have a well-established position in the groundwater profession. Although a plethora of solutions to well hydraulics problems exists, many of these are not available in useful type curve formats. In order to perform parameter estimation using many of these solutions, a computer-based form of the solution is needed. Those who have programmed analytical solutions know the difficulties that will be encountered in coding even the most innocuous-looking results. A computer-based method of type curve generation is presented based on Stehfest's method of inverting the Laplace transform solution of groundwater flow problems. The latter are usually easier to obtain than a complete closed-form solution. The method is very robust for a large class of well hydraulic problems. A companion diskette with FORTRAN source and executable example program is available from the author. (Author's abstract)
W89-13171

SIMPLE USE OF THE HAYAMI MODEL IN HYDROLOGY (UNE UTILISATION SIMPLE DU MODEL HAYAMI EN HYDROLOGIE).
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France). Section Hydrologie.
For primary bibliographic entry see Field 2E.
W89-13190

MICROCOMPUTER SOFTWARE FOR THE ANALYSIS OF WATER QUALITY SAMPLING DESIGN.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 7A.
W89-13233

MODELING WATER QUALITY IMPACTS OF HYDROPOWER RETROFITTING ON LOCKS AND DAMS OF THE LOWER OHIO RIVER.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W89-13237

DEVELOPING AN OPERATIONAL WATER TEMPERATURE MODEL FOR THE COLUMBIA RIVER SYSTEM.
Army Engineer Div. North Pacific, Portland, OR. Water Quality Section.
For primary bibliographic entry see Field 6G.
W89-13249

UTILIZING THE STATISTICAL ANALYSIS SYSTEM FOR WATER QUALITY DATA BASE MANAGEMENT.
Army Engineer District, Portland, OR.
J. D. Graham.
IN: Water Quality 88: Seminar Proceedings. February 23-25, 1988, Charleston, South Carolina. (1988). p 195-202, 2 fig, 6 ref.

Descriptors: *Water quality, *Data processing, *Statistical analysis, *Computer programs, Data interpretation.

Water quality data has been collected by numerous people for a myriad of uses. This data can be found on a variety of computer storage devices such as tapes, disks, and floppies. Analysis of this data is challenging because the concentration of chemical constituents in water may vary both spatially and temporally. A variety of techniques, including analytical and statistical, is necessary for analysis. Within the Corps of Engineers, water quality data has been analyzed by a variety of people with different hardware (micros to mainframes) and software (LOTUS, d-Base, SAS, SPS, etc.). As a result, many of the programs written are incompatible with other users programs, and there is a great deal of duplication of effort. The capabilities of the Statistical Analysis System (SAS) for water quality analysis included data storage and retrieval, data modification and programming, report writing, statistical analysis, and file handling. The system runs on IBM 370 series computers and compatibles, in batch or interactive models. It is suggested that SAS be adopted as the standard Corps-wide water quality data management system. (See also W89-13231) (Lantz-PTT)
W89-13251

CONTAMINANT MODELING FOR CORPS ACTIVITIES.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W89-13254

SIMULATION OF STEADY-STATE GROUND-WATER MOVEMENT AND SPRING FLOW IN THE UPPER FLORIDAN AQUIFER OF COASTAL CITRUS AND HERNANDO COUNTIES, FLORIDA.
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-13324

WATER-RESOURCES ACTIVITIES IN UTAH BY THE U.S. GEOLOGICAL SURVEY, JULY 1, 1987, TO SEPTEMBER 30, 1988.
Geological Survey, Salt Lake City, UT. Water Resources Div.
S. L. Dragos, and J. S. Gates.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report No. 89-240, 1989. 71p, 5 fig, 6 ref.

Descriptors: *Utah, *Data acquisition, *Data collections, *Information transfer, *Projects, Water-resources studies, Project planning.

Twenty-nine studies of water resources in Utah were conducted by the U.S. Geological Survey from July 1, 1987, to September 30, 1988. Three projects began on July 1, 1988, and three additional projects were proposed to begin on or after October 1, 1988. Twenty-four of the twenty-nine studies were in cooperation with Federal, State, County, or local agencies. The 32 current and proposed projects include 5 involved mainly with collection of data, 5 with the hydrology of Utah's energy-resource areas, 3 on floods, 2 on surface-water quality, 8 on groundwater in unconsolidated sediments, mostly in the basins of western Utah, 4 with groundwater quality, and 7 on groundwater and surface-water contamination. (USGS)
W89-13326

SIMULATION OF CHANGES IN STORM-WATER QUALITY AT FOUR POTENTIAL FLOW-ATTENUATION SITES IN THE IRONDEQUOIT CREEK WATERSHED, MONROE COUNTY, NEW YORK.
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-13332

EVALUATION OF A WATERSHED MODEL TO SIMULATE SEDIMENT TRANSPORT IN A SMALL AGRICULTURAL WATERSHED IN INDIANA.
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-13334

GEOHYDROLOGY OF THE ALLUVIUM AND TERRACE DEPOSITS OF THE NORTH CANADIAN RIVER FROM OKLAHOMA CITY TO EUFAULA LAKE, CENTRAL OKLAHOMA.
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-13341

WATER LEVEL MAPS OF THE MISSISSIPPI RIVER VALLEY ALLUVIAL AQUIFER IN EASTERN ARKANSAS, 1986.
Geological Survey, Little Rock, AR. Water Resources Div.
M. Plafcan, and L. M. Remsing.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4067. May 1989. 1 (map) sheet, 6 fig, 14 ref.

Descriptors: *Groundwater movement, *Maps, *Alluvial aquifers, *Potentiometric level, *Water level, *Arkansas, Hydraulic gradient, Hydrologic maps, Mississippi Alluvial Plains, Mississippi River Valley alluvial aquifer, Arkansas County, Cross County, Poinsett County.

The Mississippi River Valley alluvial aquifer is a major source of water for irrigation in much of eastern Arkansas. Maps of the potentiometric surface, water level change, and depth to water illustrate the effects of large withdrawals for irrigation on water levels in the aquifer. The Mississippi River Valley alluvial aquifer is composed of Quaternary Flood plain and terrace deposits. Water in the aquifer generally is confined by an upper silt and clay layer. The regional direction of groundwater flow is south and southeast, except where affected by large withdrawals for irrigation by stream reaches that are hydraulically connected with the alluvial aquifer. The largest well yields range from 1,000 to 3,000 gal/min. Recharge to the aquifer principally is by infiltration of precipitation and water for surface water bodies. Both the spring and fall potentiometric surface maps show extensive cones of depression that result from large withdrawals for irrigation-one centered beneath Arkansas County, and another beneath western Poinsett and Cross Counties. Average water level differences between the spring and fall indicate a general decline of about 3 ft. The largest declines in water levels between 1981 and 1986 and the deepest water levels in 1986 occurred in areas most affected by large withdrawals for irrigation, as shown by the water level change map and depth to water map. The largest water level declines mainly occurred in central Lonoke County and in western Poinsett County. (USGS)
W89-13351

WATER RESOURCES ACTIVITIES IN FLORIDA, 1988-89.
Geological Survey, Tallahassee, FL. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-227, 1989. 76p, 6 fig, M. E. Glenn, editor.

Descriptors: *Publications, *Florida, *Hydrologic data, *Data acquisition, *Water resources data, Water quality, Surface water, Groundwater.

This report contains summary statements of water resources activities in Florida conducted by the Water Resources Division of the U.S. Geological Survey in cooperation with Federal, State, and local agencies during 1988. These activities are part of the Federal program of appraising the Nation's water resources. Included are brief descriptions of the nature and scope of all active studies, summaries of significant results for 1988 and anticipated accomplishments during 1989. Water resources appraisals in Florida are highly diversified, ranging from hydrologic records networks to interpretive appraisals of water resources and applied research to develop investigative techniques. Thus, water-resources investigations range from basic descriptive water-availability studies for areas of low-intensity water development and management to sophisticated cause and effect studies in areas of high-intensity water development and management. The interpretive reports and records that are products of the investigations are a principal hydrologic foundation upon which the plans for development, management, and protection of Florida's water resources may be used. Water data and information required to implement sound water-management programs in highly urbanized areas relate to the quantity and quality of storm runoff, sources of aquifer contamination, injection of wastes into deep strata, underground storage of freshwater, artificial recharge of aquifers, environmental effects of reuse of water, and effects of land development on changes in ground-and surface-water quality. In some parts of the State broad areas are largely rural. Future growth is anticipated in many of these. This report is intended to inform those agencies vitally interested in the water resources of Florida as to the current status and objectives of the U.S. Geological Survey cooperative program. The mission of this program is to collect, interpret, and publish information on water resources. Almost all of this work is done in cooperation with other public agencies. (USGS)
W89-13358

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN NEW MEXICO--FISCAL YEAR 1988.
Geological Survey, Albuquerque, NM. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-473, Dec. 1988. 93p, 5 fig, 3 tab. Compiled by R. L. Knutilla.

Descriptors: *Hydrologic data collections, *New Mexico, *Water resources data, Stream gages, Observation wells, Information exchange, On-site investigations.

All hydrologic investigations in the New Mexico District in progress during fiscal year 1988 are summarized. The summaries include sections on the problems addressed, the objectives and approach of the investigation, progress of the investigation and plans for the 1988 fiscal year, and reports published as a result of the investigation. Reports released during 1986 and 1987 are listed. The New Mexico District office organization, cooperating agencies, and types of funding for the District operation are also summarized. (USGS)
W89-13367

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN PENNSYLVANIA, 1988-89.
Geological Survey, Harrisburg, PA. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-273, July 1989. 79p. Compiled and edited by R. E. Helm.

Descriptors: *Water resources data, *Hydrologic data, *Data collections, *Pennsylvania, *Publications, Information exchange.

As part of the U.S. Geological Survey Water Resources Division's objective of presenting impartial, accurate data and scientific analyses equally to all interested parties, current activities in Pennsylvania are described by a listing of project location, cooperator(s), period of project, project chief, headquarters office, problem, objective, approach, progress and plans. The basic data programs for surface water, groundwater, and water quality are described. Also included is an extensive listing of selected literature on water resources in Pennsylvania and information on obtaining these publications. A brief description of the Water Resources mission of the U.S. Geological Survey and a list of cooperators and types of funding is included and also a description of U.S. Geological Survey data bases and information sources. (USGS)
W89-13368

HYDROGEOLOGIC CHARACTERISTICS OF THE VALLEY-FILL AQUIFER IN THE ARKANSAS RIVER VALLEY, PUEBLO COUNTY, COLORADO.
Geological Survey, Denver, CO. Water Resources Div.
G. A. Nelson, R. T. Hurr, and J. E. Moore.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-256, July 1989. 3 sheets, 5 refs.

Descriptors: *Geohydrology, *Maps, *Colorado, *Alluvial aquifers, *Pueblo County, Aquifers, Groundwater, Alluvium, Water table, Arkansas River.

The hydrogeology of the valley-fill aquifer of the Arkansas River valley in Pueblo County, Colorado is presented in a series of three maps. The map shows: (1) the altitude and configuration of the bedrock surface beneath the valley-fill material; (2) the altitude and configuration of the water table in the spring of 1966; and (3) the saturation thickness of the valley-fill aquifer in the spring of 1966. (USGS)
W89-13370

HYDROGEOLOGIC CHARACTERISTICS OF THE VALLEY-FILL AQUIFER IN THE ARKANSAS RIVER VALLEY, CROWLEY AND OTERO COUNTIES, COLORADO.
Geological Survey, Denver, CO. Water Resources Div.
G. A. Nelson, R. T. Hurr, and J. E. Moore.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-255, July 1989. 3 sheets, 6 ref.

Descriptors: *Geohydrology, *Maps, *Colorado, *Alluvial aquifers, *Crowley County, Otero County, Aquifers, Groundwater, Alluvium, Water table, Arkansas River.

The hydrogeology of the valley-fill aquifer of the Arkansas River valley in Crowley and Otero Counties, Colorado is presented in a series of three maps. The map shows: (1) the altitude and configuration of the bedrock surface beneath the valley-fill material; (2) the altitude and configuration of the water table in the spring of 1966; and (3) the saturation thickness of the valley-fill aquifer in the spring of 1966. (USGS)
W89-13371

HYDROGEOLOGIC CHARACTERISTICS OF THE VALLEY-FILL AQUIFER IN THE ARKANSAS RIVER VALLEY, PROWERS, COLORADO.
Geological Survey, Denver, CO. Water Resources Div.
G. A. Nelson, R. T. Hurr, and J. E. Moore.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-254, July 1989. 3 sheets, 6 refs.

Descriptors: *Geohydrology, *Maps, *Colorado, *Alluvial aquifers, *Prowers County, Aquifers, Groundwater, Alluvium, Water table, Arkansas River.

The hydrogeology of the valley-fill aquifer of the Arkansas River valley in Prowers County, Colorado is presented in a series of three maps. The map shows: (1) the altitude and configuration of the bedrock surface beneath the valley-fill material; (2) the altitude and configuration of the water table in the spring of 1966; and (3) the saturation thickness of the valley-fill aquifer in the spring of 1966. (USGS)
W89-13372

PRELIMINARY ANALYSIS OF THE SHALLOW GROUNDWATER SYSTEM IN THE VICINITY OF THE GRAND CALUMET RIVER/INDIANA HARBOR CANAL, NORTHWESTERN INDIANA.
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-13376

ALASKA INDEX: STREAMFLOW, LAKE LEVELS, AND WATER QUALITY RECORDS TO SEPTEMBER 30, 1988.
Geological Survey, Anchorage, AK. Water Resources Div.
P. J. Still, and J. M. Cosby.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-269, 1989. 189p, 6 fig, 6 tab.

Descriptors: *Data collections, *Hydrologic data, *Lakes, *Water resources data, *Water quality, *Streams, *Alaska, Streamflow, Water chemistry, Water temperature, Sediments, Water biology, Lake levels.

Streamflow, lake levels, and water quality data are compiled for stations in the southeast, south-central, southwest, Yukon basin, northwest, and Arctic Slope subregions of Alaska. The report includes a map of each hydrologic subregion and tables listing types of data collected and periods of records. (USGS)
W89-13378

HYDROLOGIC DATA: SOUTH BRANCH CASSELMAN RIVER, GARRETT COUNTY, AND MARSH RUN, WASHINGTON COUNTY, MARYLAND.
Geological Survey, Trenton, NJ. Water Resources Div.
J. T. Hilleary.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 84-426, 1984. 63p, 9 fig, 2 pl, 17 tab, 7 ref.

Descriptors: *Groundwater resources, *Water resources data, *Wells, *Springs, *Maryland, *Washington county, Water level, Hydrographs, Lithologic logs, Garrett County.

This report is a compilation of well construction data, lithologic and geophysical logs, and water level and water quality data for selected wells and springs in the South Branch Casselman River and Marsh Run drainage basins, Garrett and Washington Counties, Maryland. The report contains, for the two areas combined, records of 202 wells and 57 springs; periodic water level measurements and field determinations of specific conductance, pH, and water temperature for 33 wells and 7 springs; geophysical logs for 1 well and lithologic logs for 113 wells; and multi-year water-level data for 9 observation wells. (USGS)
W89-13379

LOW-FLOW PROFILES OF THE UPPER CHATTAHOOCHEE RIVER AND TRIBUTARIES IN GEORGIA.
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-13384

DEVELOPMENT OF A COMBINED QUANTITY AND QUALITY MODEL FOR OPTIMAL MANAGEMENT OF UNSTEADY GROUNDWATER FLOW FIELDS.

Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W89-13400

QUALITATIVE AND QUANTITATIVE AQUATIC ALGAL DATA COMPILATION TO DETERMINE MACROTRENDS-IV.
Arkansas Univ., Fayetteville. Dept. of Botany and Microbiology.
R. L. Meyer.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-214456/AS. Price codes: A03 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Publication No. 133, June 1988. 7p, 6 ref. USGS Project G-1409-32.

Descriptors: *Algae, *Taxonomy, *Classification, *Arkansas, *Data collections, Cyanophyta, Cyanobacteria, Habitats, Lakes, Reservoirs, Streams.

A data base of the algae of Arkansas ecoregions has been established by the use of a relational data base management system (dBase III plus). The system was chosen to be readily available for a variety of microcomputers using MS-DOS and PC-DOS. The data base contains taxonomic fields from division through variety, synonymy, authors, initial description, date, and definitive descriptive source. The data are cross-referenced by ecoregion, Round's community and subcommunity designations. The data base contains more than 1,500 taxonomic records in all divisions and classes of freshwater algae. The data are sortable by any of the included parameters. The data have been used to initiate the publication of the algal flora of Arkansas. The listing of the Cyanophyta/Cyanobacteria or blue-green algae is presently available. Other taxonomic lists are in preparation. (Meyer-AR U., WRRC)
W89-13401

GROUNDWATER RESOURCES ASSESSMENT OF THE PIEDMONT REGION IN SOUTH CAROLINA.
Clemson Univ., SC. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W89-13407

8. ENGINEERING WORKS

8A. Structures

FROM CANALS TO LAKES IN SOUTHEAST QUEENSLAND (AUSTRALIA): WATER QUALITY ASPECTS.
For primary bibliographic entry see Field 5G.
W89-12240

CLASSIFYING AND SELECTING SMALL HYDRO SCHEMES.
Halcrow (William) and Partners, Swindon (England).
For primary bibliographic entry see Field 8C.
W89-12408

MAPPING TECHNIQUES TO CUT SMALL HYDRO COSTS.
Balfour Beatty Engineering Ltd., Kent (England).
For primary bibliographic entry see Field 7B.
W89-12410

CONSTRUCTION OF A WATERTIGHT DIAPHRAGM BY THE BARRETTE METHOD WITH THE USE OF A BARRAGE MACHINE.
For primary bibliographic entry see Field 5G.
W89-12462

POLYMER-CEMENT SHOTCRETE AT THE CONSTRUCTION OF THE DANGARA HYDRAULIC TUNNEL.
For primary bibliographic entry see Field 8F.
W89-12463

EVALUATION OF THE STABILITY OF A CHANNEL WITH PARTIAL REVETMENT.
For primary bibliographic entry see Field 4D.
W89-12466

USE OF ANALOG VALUES OF RHEOLOGICAL PROPERTIES OF CONCRETE.
For primary bibliographic entry see Field 8F.
W89-12472

INVESTIGATION OF THE STABILITY OF BOREHOLE BENCH MARKS IN THE LOWER POOL OF THE BRATSK DAM.
V. G. Ivanov, M. D. Timofeev, and Z. I. Soloveva.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 7, p 446-449, January 1989. 3 fig, 5 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 7, p 59-61, July 1988.

Descriptors: *Dams, *Surveying instruments, *Dam stability, *Boreholes, Bench marks, Elevation, USSR.

The traditional scheme of transferring the absolute elevations from the distant reference bench marks to settlement marks of a structure is usually used for determining the settlements of dams and other large structures. One of the principle virtues of this scheme is the location of the bench marks outside the zone of settlement from the structure's load. One of the principle shortcomings of this scheme is the great distance of the bench marks, as a consequence of which errors accumulate in the levelling line, distorting the values of settlements of the structures. One of the variants of eliminating the shortcomings of this scheme was to embed two clusters of borehole bench marks in the lower pool of the Bratsk Dam. The bench marks are rods made up of segments of 60-mm-diameter galvanized pipes filled with cement slurry. Borehole bench marks work just as practically as the settlement marks of the data and surface cliff bench marks located near the dam. Consequently, with such a scheme of embedding the bench marks it was not possible to fall outside the zone of formation of settlement, and the given borehole bench marks cannot serve as a reliable, independent reference for determining dam settlements. Observations of their operation for five years permit the conclusion that such bench marks, even with a rod length up to 150 m, are sufficiently stable per se as height marks and can be used as reference bench marks. It is hoped to solve the problem of obtaining a stable reference height mark near the structure in the future by studying another cluster of bench marks embedded into the sandstone stratum, i.e., the zone of formation of settlement. (Fish-PTT)
W89-12473

RISK ANALYSIS FOR DAM DESIGN IN KARST.
S. G. Vick, and L. G. Bromwell.
Journal of Geotechnical Engineering (ASCE) JGENDZ, Vol. 115, No. 6, p 819-835, June 1989. 8 fig, 3 tab, 25 ref.

Descriptors: *Risk assessment, *Dam design, *Dams, *Hydraulic structures, *Karst, Design criteria, Safety, Geologic formations, Probabilistic process, Planning, Model studies, Dam failure, Geohydrology.

Probabilistic risk analysis is a useful technique in assessment of dam safety issues, and also has important applications in the early phases of dam design when design options are being compared and exploration strategies planned. At this stage, few data are usually available and judgment-based decisions are most important. An application of probabilistic risk analysis to design of a dike in karst terrain is described. Assessments based on geologic information, observations, and subsurface investigations are expressed using a simple probability model. Options considered to reduce the likelihood or consequences of sinkhole-induced failure include a secondary containment structure, a warning system, and additional exploration. These options are evaluated using an expected monetary value criterion. It is shown that simple probabilistic formulations consistent with preliminary levels of information reduced major sinkhole uncertainties into more readily evaluated components. These techniques identified the most cost-effective design strategy for reducing the risk of sinkhole-induced dike failure and provide an effective vehicle for communicating geotechnical judgments, risk, and alternatives to the project owner. (Author's abstract)
W89-12628

SEEPAGE AND CONTRACTION JOINTS IN CONCRETE CANAL LININGS.
Bookman-Edmonston Engineering, Inc., Glendale, CA.
J. Kishel.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 115, No. 3, p 377-383, June 1989. 2 fig, 1 tab, 5 ref, append.

Descriptors: *Construction joints, *Construction methods, *Sealants, *Canal construction, *Seepage, *Canal seepage, *Canal linings, *Conveyance structures, Hydraulic structures, Concretes, Water loss, Construction costs, Economic justification, Water conveyance, Leakage.

Contraction joints in concrete canal linings are often provided with waterstops or joint sealants on the assumption that the cost of these provisions will be justified by a corresponding reduction in water lost to seepage through the lining. However, little evidence presently exists in the literature to support this conclusion. Seepage rate from a large, concrete-lined canal with unsealed contraction joints was evaluated through full-scale field testing. Testing consisted of water level and evaporation observations for a ponded 6-mi (9.6-km) length of the Santa Rosa Canal over a nine-day period. The observed seepage rate is compared with seepage rates reported for similar canals with sealed contraction joints. The comparison indicates that contraction joint seals have little significant mitigating effect on canal seepage rate. The magnitude of typical joint sealing costs, relative to the test results, indicate that the cost of sealing contraction joints in concrete canal linings may not be economically justified by a corresponding decrease in canal seepage. (Author's abstract)
W89-12633

INITIAL MICROPERIPHYTON PRODUCTION IN THE RESERVOIR/COOLANT OF AN ATOMIC POWER STATION (PERVICHNAIA PRODUKTSIIA MIKROPERIFITONA VODOEMA-OKHLADITELYA ATOMMOI ELEKTROSTANTSII).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 2H.
W89-12716

DAMMING OF THE ANGARA RIVER AT THE SITE OF THE BOGUCHANY HYDROELECTRIC STATION.
G. G. Lapin, A. M. Martines, N. A. Seredintsev, and A. V. Shlychkov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 8, p 456-463, February 1989. 4 fig, 1 tab, 3 ref.

Descriptors: *Hydroelectric plants, *Dam construction, *Dam design, *Hydraulic models, Computer models, Flow control, Flow regulators, Reservoir releases, Construction costs, Construction equipment, Construction materials, USSR.

The Boguchany hydrostation and the Lower Angara hydrostation being planned downstream are the closing links of the cascade of Angara River hydrostations in the Soviet Union. A characteristic feature of the Angara River at the site of the Boguchany hydrostation is the high degree of streamflow regulation, which is explained by the great regulating capacity of the reservoirs of the upstream hydrostations. Circumstances compelled searching for ways to facilitate the conditions of damming and accordingly to reduce the cost of these works and to resort to a scheme of damming

at two sites. The damming plan was preliminarily thoroughly investigated on a three-dimensional nonerodible hydraulic model, by entering the hydraulic characteristics of the damming, which coincided well with the design. Then the process of damming, including the size of the fill material, placement rate, and the process of damming itself over time, was modelled on an erodible model. Damming of river channels at two or several sites with large final heads was found to be possible and expedient, since it makes it possible to considerably facilitate the damming conditions, to reduce the volume of oversize stone and concrete blocks, and thereby to reduce the cost of the damming works. State-of-the-art organizational techniques and equipment at the site of hydrologic developments make it possible to maintain the prescribed damming parameters. (Fish-PTT)
W89-12899

ELIMINATION OF COFFERDAMS WHEN CONSTRUCTING HYDROELECTRIC STATIONS.
For primary bibliographic entry see Field 8H.
W89-12900

THERMAL STRESS STATE OF AN UNDERGROUND POWERHOUSE ROOF DURING CONSTRUCTION AND OPERATION.
For primary bibliographic entry see Field 8E.
W89-12901

CONSIDERATION OF THE NATURAL DRAFT WHEN VENTILATING UNDERGROUND WORKINGS IN MOUNTAINOUS AREAS.
M. A. Reznikov, and L. P. Kachalina.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 8, p 476-480, February 1989. 2 fig, 6 ref.

Descriptors: *Ventilation, *Hydroelectric plants, *Air entrainment, Air circulation, Air temperature, Mountains, Pressure distribution, Construction methods, Computer programs, USSR.

Expansion of the construction of hydrotechnical facilities is related to their siting in difficultly accessible mountainous regions of the Soviet Union, characterized by a specific terrain conducive to the occurrence of a natural draft through underground workings. The natural draft of shafts and mines is presently calculated from the difference of pressures of arbitrary air columns (outside and inside) referred to one of the mouths of the workings. The indicated method has sufficient accuracy in flat terrain. The mountainous relief of the region of a complex of underground workings of a hydroelectric station requires special consideration, since it substantially changes the temperature regime of slopes and intensifies the effect of the natural draft on the air distribution in the complex network of workings and operating regimes of the ventilators. The method presented for calculating the natural draft pressure drop of single tunnels reflects the specific characteristics of hydrotechnical construction in mountainous areas and for the first time takes into account the direction of movement of the ventilation flow. For calculating the natural draft pressure drop of a complex network of underground workings, an algorithm was developed which makes it possible to calculate the air distribution in the underground complex being constructed in relation to a number of technological and natural factors, by a standard program on a computer. The selection of the types and arrangement of the ejector fans was optimized on the basis of analysis of different variants of the air distribution. (Fish-PTT)
W89-12902

SYSTEMATIZATION OF DAM DEFORMATIONS ON THE BASIS OF RESULTS OF GEODETIC MEASUREMENTS.
For primary bibliographic entry see Field 8E.
W89-12905

ANALYSIS OF THE BEHAVIOR AND STRENGTHENING OF LOCK DOCK WALLS.
O. D. Rubin, R. V. Umnova, and V. E. Ni.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 8, p 505-509, February 1989. 2 fig, 1 tab, 3 ref.

Descriptors: *Locks, *Concrete testing, Deformation, Mechanical failure, Tensile stress, Tension, Cracks, Reinforced concrete, Strength, On-site investigations, Load distribution, Model studies, Model testing, Economic efficiency, USSR, Canals, Moscow Canal.

Chambers of dock-type locks with solid floors operating over a long period of time can accumulate residual deformations of the top of the wall sections toward the chamber, which necessitates taking measures to prevent this phenomenon. Cracks form in the reinforced concrete lock walls, the stresses in the longitudinal reinforcement of the zone of tension can reach the ultimate values, and the concrete of the face can have increased water absorption. An analysis of the results of on-site observations of the behavior of the walls of the Moscow Canal locks showed the need for an experimental substantiation of the variant of strengthening the walls with the installation of additional reinforcement in the zone of tension. Experimental investigations of scale models of the lock walls were performed wherein brief static loads corresponding to the formation of inclined cracks and fracture of the models and maximum loads absorbed by the models after strengthening were recorded. Among the unfavorable factors promoting the formation of cracks in walls is the pronounced decrease of the amount of longitudinal main reinforcement in the zone of the construction joints. Calculations of the model of the lock wall showed good agreement with the experiment. The results of testing the models showed that the method of strengthening restoration of the longitudinal reinforcement and performance of the lock walls on the face side by installing inclined stirrups is rather preferable both with respect to bearing capacity and with respect to economical indices. The measures on strengthening should be primarily directed at eliminating the causes which led to a decrease in reliability of the structural members. (Fish-PTT)
W89-12909

ACTIVE MANAGEMENT OF AN ARTIFICIAL ROCKY COAST.
Ministry of Transport and Public Works, The Hague (Netherlands). Tidal Waters Div.
For primary bibliographic entry see Field 2L.
W89-12945

ANALYSIS OF THE LINEAR PROGRAMMING GRADIENT METHOD FOR OPTIMAL DESIGN OF WATER SUPPLY NETWORKS.
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
A. Kessler, and U. Shamir.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1469-1480, July 1989. 2 fig, 2 tab, 13 ref, 3 append. NSF grant CEE8408369.

Descriptors: *Network design, *Water distribution, *Conveyance structures, *Linear programming, Water conveyance, Systems analysis, Flow characteristics, Mathematical analysis, Hydraulic design.

A theoretical analysis of the linear programming (LP) gradient method for optimal design of water distribution networks is presented. The method consists of two stages that are solved in alteration: (1) a LP problem is solved for a given feasible flow distribution and (2) a search is conducted in the space of flow variables, based on the gradient of the objective function (GOF). A matrix formulation is given for both stages using graph theory matrices. It is shown that the mathematical expression of the GOF is independent of the choice of the sets of loops and paths along which the head constraints are formulated, which is contrary to a previously published claim. The original GOF expression is shown to have been an approximation of the steepest direction, but still gives good results. The search procedure is improved by using the projected gradient method. (Author's abstract)
W89-12974

DIFFUSION APPROXIMATION FOR EQUILIBRIUM DISTRIBUTION OF RESERVOIR STORAGE.
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
S. G. Buchberger, and D. R. Maidment.
Water Resources Research WRERAQ, Vol. 25, No. 7, p 1643-1652, July 1989. 5 fig, 5 tab, 21 ref. USGS contract 14-08-0001-G1318.

Descriptors: *Reservoir design, *Storage reservoirs, *Reservoir capacity, Mathematical studies, Statistical analysis, Monte Carlo method, Numerical analysis.

The Fokker-Planck equation is used to describe the evolution through time of the probability density function of storage levels between the boundaries of a finite reservoir. Analytical solutions for the equilibrium density function are obtained under the assumption that potential storage displacements are independent stationary Gaussian random variables. The potential storage displacement represents the change in storage that would occur during a unit time interval in a reservoir of infinite capacity. Results show that the storage density function is a mixed truncated exponential distribution with mass concentrations on the lower and upper boundaries corresponding to the steady state probability that the reservoir is empty or full respectively. Parameters of the equilibrium storage density function are computed from the reservoir capacity and the mean and variance/unit time of the potential storage displacement. A dimensionless parameter, analogous to a Peclet number, identifies conditions for which the finite reservoir effectively behaves as one with semi-infinite capacity. Analytical solutions from the diffusion approximation show excellent agreement with independent estimates of the storage distribution function obtained using probability matrix methods, Monte Carlo simulation, and numerical methods. (Author's abstract)
W89-12990

EARTHQUAKE ANALYSIS OF INTAKE-OUTLET TOWERS INCLUDING TOWER-WATER-FOUNDATION-SOIL INTERACTION.
California Univ., Berkeley. Dept. of Civil Engineering.
A. Goyal, and A. K. Chopra.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 18, No. 3, p 325-344, April 1989. 8 fig, 1 tab, 26 ref. NSF Grants CEE-8401439 and CES-8719296.

Descriptors: *Dam design, *Earthquake engineering, *Structural engineering, *Hydrodynamics, *Intake-outlet towers, Mathematical analysis, Briones Dam, California.

The available procedure for earthquake analysis of axisymmetric intake-outlet towers was extended to towers of arbitrary geometry, but with two axes of plan symmetry, and to include the effects of tower-foundation-soil interaction. The total system is represented as four substructures: tower, surrounding water, contained water and the foundation supported on flexible soil. The substructure representation of the system permits use of the most effective idealization for each substructure. An example earthquake response analysis demonstrates the results obtained from the analysis procedure. Computation times for the complete analysis of Briones Dam Intake Tower (near San Francisco Bay, CA) for six cases in which the parameters describing the foundation soil, surrounding water and inside water were varied, ranged from 4.9 to 9.4 sec of CPU time on an IBM 3060 computer. (Sand-PTT)
W89-13032

ARCH DAM SYSTEM IDENTIFICATION USING VIBRATION TEST DATA.
Houston Univ., TX. Dept. of Civil and Environmental Engineering.
S. T. Mau, and S. Wang.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 18, No. 4, p 491-505, May 1989. 7 fig, 2 tab, 22 ref. NSF Grant ECE-8520599.

Descriptors: *Model studies, *Arch dams, *Dam design, *Structural engineering, *Vibration testing, *Hydrodynamics, Mathematical analysis, Santa Anita Dam, Morrow Point Dam.

In an effort to study the dynamic characteristics of an arch dam system from the vibration test results, a systematic method of frequency-domain system identification was developed. The governing equations for system identification are based on a non-classical model superposition method. The non-classical model was derived from a general matrix formulation of the dam system. The conventional classical model formulation becomes a special case of the general non-classical formulation. The model parameters of the non-classical and the classical formulation are to be identified. The system identification method includes a single-mode sweep procedure for initial parameter estimation and a progressive multiple-mode parameter identification scheme that contains an information criterion for the determination of the optimal number of modes to be included in the identification process. The method is applicable to data measured at more than one point on the dam and to data that include both the amplitude response and the phase response. The method is applied to the vibration test data of two dams. Based on the results of these applications, the adequacy of the classical model and the non-classical model was compared. For the two arch dam data, the non-classical solution fit was consistently better than that of the classical solution. Comparison of data from the Santa Anita dam in California and the Morrow Point dam in Colorado showed a small discrepancy between the test data and the non-classical solution when the reservoir effect is present which suggests the presence of frequency dependent characteristics of the dam-foundation-reservoir system caused by the reservoir effect. (Sand-PTT)
W89-13033

WATER PRESSURES ON RIGID GRAVITY DAMS WITH FINITE RESERVOIR DURING EARTHQUAKES.
Universidad Autonoma de Puebla (Mexico). Escuela de Ingenieria Civil.
J. Aviles, and F. J. Sanchez-Sesma.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 18, No. 4, p 527-537, May 1989 7 fig, 10 ref.

Descriptors: *Gravity dams, *Dam design, *Earthquake engineering, *Structural engineering, *Hydrodynamics, *Reservoirs, Mathematical analysis.

An approximate analytical solution is presented for earthquake-induced hydrodynamic pressures on rigid gravity dams with a finite reservoir and incompressible fluid. Using the Treffitz-Mikhlin method, the solution was constructed with function expansions of solutions of the problem's governing equation which satisfy boundary conditions at the bottom and free surface. Unknown coefficients of the linear combinations were obtained from a continuous least-squares treatment of the remaining boundary conditions at the upstream dam face and reservoir wall. Numerical results are presented for different geometries of the dam-water and wall-water interfaces. Out-of-phase motion at the end of the reservoir is considered. When the upstream dam face and reservoir wall are vertical, the known solution for in-phase dam and wall movement is recovered. In all cases, pressure distribution depends on the geometry of the upstream dam face. (Sand-PTT)
W89-13034

EFFECTS OF CONCRETE CRACKING ON THE EARTHQUAKE RESPONSE OF GRAVITY DAMS.
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8F.
W89-13035

PROVISION OF RELIABILITY AND ECONOMY OF MODERN CONCRETE-FACED ROCK-FILL DAMS.
Y. P. Lyapichev, and I. N. Ivaschenko.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 10, p 563-569, April 1989. 3 fig, 2 tab, 12 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 9-15, October 1988.

Descriptors: *Dams, *Rockfill dams, *Earthquake engineering, Concrete construction, Performance evaluation, Reliability, Construction methods, Cost analysis, Low-head hydroelectric plants, Dam construction, USSR, Latin America, United States, Southeast Asia, Earth dams, Comparison studies.

During past 10-15 yr, construction time and time to bringing low-head hydroelectric plants online has been reduced considerably by using rockfill dams with a concrete facing rather than earth-rock dams. During the past 20 yr, about 50 concrete-faced rockfill dams with a height greater than 50 m have been built worldwide (mainly in Latin America, Southeast Asia, and the United States). Dams of this type are being constructed under diverse natural conditions, including rock and cohesive soil foundations. Of particular importance is the reliability of concrete facings and the dam as a whole under seismic loads. The high reliability of this type of dam during earthquakes is determined primarily by the absence of water saturation of the fill soils and, consequently, danger of their liquefaction, as well as by the favorable hydrostatic surcharge of the facing and body of the dam. A low position of the water level is the most dangerous in terms of seismic stability. The occasionally expressed opinion that modern rockfill dams have less seismic stability than rock-earth dams with clay cores is completely wrong. The main technical-economic advantages of concrete-faced rockfill dams compared to the rock-earth dams with clay cores in wide use in the Soviet Union. These advantages include: substantially smaller volume of fill, less volume and construction time needed before the first hydrostations can be brought online, technical simplicity and convenience in placing dam components, greater possibility in using inequigranular mined rock without grading and intermediate stockpiling, smaller cost of preparing the rock foundation, greater adaptability to passing flood peaks through the dam during construction, less dependence on climatic conditions when placing the antiseepage element, and ease and accessibility of inspection and simplicity of facing repairs. The Salvajina Dam (Columbia, 148 m) illustrates many of the characteristics of modern high earth dams. It has provided reliable operation. (Rochester-PTT)
W89-13098

SEISMIC STABILITY OF THE HYDRAULIC-FILL DAM OF THE KAIRAKKUM HYDROELECTRIC STATION.
V. A. Melent'ev, N. D. Krasnikov, V. I. Khor'kov, M. P. Pavchich, and T. A. Sozinova.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 10, p 570-573, April 1989. 3 fig, 2 tab, 8 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 15-18, October 1988.

Descriptors: *Dams, *Earth dams, *Earthquake engineering, USSR, Kairakkum Hydroelectric Station, Performance evaluation, Dam construction, Construction methods, Hydraulic fill, Mathematical analysis.

The hydraulic-fill dam of the Kairakkum hydroelectric station on the Syr Darya River (Soviet Union), with a maximum height in the channel section of 28 m and a crest length of 1200 m, was constructed in 1954-1955. The maximum head is 20 m. The Kairakkum dam, which has an upstream berm of stone and gravel-pebble soil and a thick downstream drainage berm in the channel part, was hydraulically filled with fine and medium unrounded sands. The upstream slope along the entire length of the dam was reinforced with a layer of stone with a size up to 1 m at a thickness of 1.2 m, placed on a gravel soil bed of 0.7-1.0 m thickness. This revetment proved sufficient to withstand wind waves with the design height up to 2.5 m. Studies in 1955 determined the dynamic stability of the Kairakkum dam's water-saturated sands in a vibrating flume. An earthquake occurring on October 13, 1985 affected 3500 sq km, including the region of the dam. Analysis of soil and structure damage in the vicinity resulted in an estimate of the earthquake intensity in Kairakkum and at the site of the hydrostation at 8 on the Richter scale, with the most intense ground motions in the range of dominant frequencies from 4 to 6 Hz. The seismic inertial loads on the dam were determined by a simplified sliding-wedge method and the seismic stability of the slopes was checked by Mozhevitinov's method. The resulting data confirmed that the seismic stability of the Kairakkum dam is adequate. (Rochester-PTT)
W89-13099

ARPA-SEVAN TUNNEL.
K. A. Babayan, N. V. Dmitriev, A. M. Mardzhanyan, V. M. Mostkov, and A. V. Sarkisyan.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 10, p 574-583, April 1989. 4 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 18-25, October 1988.

Descriptors: *Tunnels, *USSR, *Tunnel failure, Tunnel linings, Tunnel construction, Interbasin transfers, Lake Sevan, Arpa River, Ekhegis River, Rock properties.

Lake Sevan, one of the world's few high-mountain freshwater lakes, is located in the northeastern part of Armenia at an elevation of 1916 m. The amount of water in the lake in its natural state is 58.5 cu m, with a surface area of 1416 sq km and a maximum depth of 99 m. The lake has been used extensively for irrigation and hydropower since the 1930s. Starting in 1965, however, the releases from the water have been progressively reduced and currently an effort is under way to stabilize the lake level. Part of this effort is the diversion of runoff from the Arpa River and its tributary the Ekhegis River into the lake via a tunnel. The construction of this tunnel and subsequent problems and how they were managed are discussed here. The Arpa-Sevan tunnel (actually two tunnels of 48.4 km total length with an open section between) is unusual in terms of its length, depth, engineering-geological conditions, the presence of thick faults, high gas pressures, large rock pressure, and inflows of geothermal waters. The extreme depth of the tunnel (maximum depth 1230 m) contributed to disturbance of the hydraulic regime of the tunnel. Rock strength and deformability decreased and movements and rock pressure on the tunnel lining increased unpredictably. Damage of the tunnel lining after 5 yr on less than 10% of the total length was not considered extreme in view of the unusual conditions present. Only 5% of the lining needed to be totally reconstructed. Future designs should take into account the effects of saturation on rock properties. Automated monitoring equipment should be used in tunnels where passage of water is constant. (Rochester-PTT)
W89-13100

HYDRAULIC CALCULATION OF THE TRENCH INTAKE OF THE SPILLWAY OF THE KAPSK RESERVOIR.
For primary bibliographic entry see Field 8B.
W89-13101

STREAM-DIRECTING WORKS OF THE UPPER POOL OF OVERFLOW SPILLWAYS.
For primary bibliographic entry see Field 8B.
W89-13102

CALCULATION OF THE STRESS-STRAIN STATE OF EARTH STRUCTURES WEAKENED BY LOW-STRENGTH INTERLAYERS.
V. V. Skopetskii, V. S. Deineka, and S. I. Rybachishin.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 10, p 591-597, April 1989. 3 fig, 10 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 31-35, October 1988.

Descriptors: *Hydraulic engineering, *Earthworks, *Stress-strain analysis, Mathematical equations, Earth dams, Embankments, Soil properties, Ice inclusions, Cracks, Interlayers.

Thin layers of low-strength material often are found in the foundations of embankments and dams, dam abutments, and other objects. Such interlayers (despite the fact their thicknesses can be considerably less relative to the characteristic dimensions of the structures) have a substantial effect on the stress-strain state (SSS) of the soil mass. With a decrease of strength of the low-strength inclusions (e.g., due to the intrusion of water into them or thawing) or increase in the external load applied to the soil medium, considerable deformations develop along the interlayer (and the deformations above and below the interlayer differ substantially among themselves), and a redistribution of stresses in the soil medium also occurs. Methods are described for investigating the SSS of natural slopes, underground works, structures containing low-strength and melting ice inclusions, extended cracks, and other objects weakened by long and short inclusions. The effect on the SSS of the structure of the coefficient of shear rigidity of the interlayer for various locations of the inclusion and its various operating conditions is analyzed. Both coefficient of shear rigidity of the interlayer (r) and the operating regimes of the structure have a substantial effect on the SSS of earth structures. Even under the effect of gravity alone, the presence of a low-strength interlayer qualitatively and quantitatively affects the SSS of the structure. In turn, a short inclusion in the upstream pool side leads to a still greater increase of displacements above the interlayer toward the upper pool. The presence of a hydrostatic surface load for the left short inclusion leads to the formation of stress concentration on its right end. For a long inclusion, the formation of a zone of tensile stresses above the interlayer is observed near the left foundation of the dam during filling of the pool. The presence of a long interlayer leads to an increase of settlement of the dam crest. In all operating regimes of the structure, a discontinuity of the fields of displacements (Ux), components of the stress tensor (delta sub x), and other characteristics occurs along the low-strength inclusion. (Rochester-PTT)
W89-13103

USE OF MUSHY CONCRETES IN CONSTRUCTION OF THE INGURI HYDROELECTRIC STATION.
For primary bibliographic entry see Field 8F.
W89-13104

EVALUATION OF THE CONCRETE QUALITY OF THE SAYANO-SHUSHENSKOE DAM FROM CORES.
For primary bibliographic entry see Field 8F.
W89-13106

STATIC BEHAVIOR OF THE SAYANO-SHUSHENSKOE DAM IN THE LAST STAGES OF FILLING THE RESERVOIR.
E. K. Aleksandrovskaya.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 10, p 607-612, April 1989. 4 fig, 8 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 43-48, October 1988.

Descriptors: *USSR, *Concrete testing, *Dam construction, *Concrete dams, Sayano-Shushenskoe Dam, Arch dams, Gravity dams, Dam failure, Reservoirs, Hydrostatic loading, Grouting, Seasonal variation, Construction joints.

Monitoring of the static state of the Sayano-Shushenskoe Dam (Soviet Union) by onsite observations and investigations has been under way since the start of construction. The rise in the upper pool level (UPS) in 1985 above elevations 500-510 m was marked by certain previously unobserved phenomena characterizing a qualitatively new stage of the static behavior of the gravity-arch dam. These phenomena included, in particular, an abrupt opening of the contact joint under the upstream face of several sections of the dam and activation of seepage processes throughout the entire stratum of the rock foundation and bank abutments. Disturbance of the cohesion at the concrete-rock contact occurred as early as in the construction period, before filling of the reservoir, when under the upstream face of three of the five monitored sections tensile strains were observed. Opening of the concrete-rock contact under the first columns of the channel sections of the dam at an elevation of the upper pool level that had still not reached the normal pool level is a consequence of the fact that the dam annually absorbed the increasing hydrostatic load as a weakened profile having offsetting zones of ungrouted concrete. Local disturbance of the grout curtain under the channel sections of the dam can be established on the basis of observations of the seepage regime in the rock. Seepage pressure in the body of the dam is observed both in the construction joints extending to the upstream face of the structure and in the massive concrete of the first column. The pressure decreases somewhat with expansion of the concrete, creating an additional reserve of compression near the upstream face. Seasonal opening of joints, observed to a depth of 1.5 m from the downstream face, has a noticeable effect on stresses near this face. The values of stresses near the downstream face are less than were calculated, because the measurement points specified under the assumption of constructing the dam full profile were in the offset concrete. More detailed investigations will be needed to more accurately evaluate the state of the dam in the last stage of filling the of the reservoir. (Rochester-PTT)
W89-13107

LEAST-COST DESIGN OF AQUEDUCT SYSTEMS.
Iowa Univ., Iowa City. Inst. for Economic Research.
For primary bibliographic entry see Field 5F.
W89-13128

CONVEYANCE AND STORAGE OF PURIFIED WATER.
For primary bibliographic entry see Field 5F.
W89-13225

REAERATION AT LOW-HEAD STRUCTURES: PRELIMINARY RESULTS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 5G.
W89-13236

GROUND WATER MANAGEMENT PLAN FOR THE CONSTRUCTION OF THE BONNEVILLE NAVIGATION LOCK.
Army Engineer District, Portland, OR.
For primary bibliographic entry see Field 5G.
W89-13252

8B. Hydraulics

NUMERICAL FLOW SIMULATIONS IN FRANCIS TURBINES.
Sulzer-Escher Wyss Ltd., Zurich (Switzerland).
For primary bibliographic entry see Field 8C.
W89-12403

BED-SURFACE SIZE CHANGES IN GRAVEL-BED CHANNEL.
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2J.
W89-12412

SIMPLE GROUNDWATER LABORATORY MODELS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Div. of Engineering Fundamentals.
For primary bibliographic entry see Field 2F.
W89-12417

ESTIMATION OF SILTATION OF THE TERBLYA-RIKA HYDROELECTRIC STATION RESERVOIR.
For primary bibliographic entry see Field 2J.
W89-12471

GLACIAL WATERS, CARRIAGE OF SOLID MATERIALS AND DECANTATION IN HYDRO-ELECTRICITY (EAUX GLACIAIRES, TRANSPORTS SOLIDES ET DECANTATION EN HYDRO-ELECTRICITE).
Grande Dixence Societe Anonyme, Sion (Switzerland).
A. Bezinge, and R. Aeschlimann.
Houille Blanche HOBLAB, Vol. 1989, No. 3-4, p 247-256, 1989. 12 fig, 21 ref. English summary.

Descriptors: *Hydroelectric plants, *Trap efficiency, *Flow control, *Glacial sediments, *Sediment transport, *Hydraulic machinery, *Intakes, Sand, Gravel, River flow, Water level fluctuations, France, Compensating reservoirs, Settling basins.

Grande Dixence S.A., is a large hydroelectric scheme in the mountains of France. It was built from 1953-1965 and has been in operation since. It has 27 sand and gravel traps of the GD-EdF type, 10 gravel traps, and 11 classical sand traps. This study presents a synthesis of trap experiments as well as those made on an original floating water intake of a compensating basin with a water level variation of 30 meters. Finally, the actual conception of a river water intake and sand trap with a transverse throughflow is presented with possible future improvements on sand traps. (Author's abstract)
W89-12889

CALCULATION OF RESERVOIR SILTATION.
For primary bibliographic entry see Field 2J.
W89-12903

ESTIMATION OF SNOWDRIFT FILLING OF SECTIONS OF EARTH CANALS.
S. I. Kuts.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 8, p 499-501, February 1989. 2 fig, 2 ref.

Descriptors: *Hydraulic structures, *Snowdrift, *Drifting snow, *Canal design, *Snow management, Statistical analysis, Field tests, Wind velocity, Snow accumulation, Snow removal, Canal construction, USSR.

The practice of operating existing hydraulic engineering complexes under conditions of a harsh climate, such as in the Soviet Union, has revealed a number of difficulties in delivering water along open earth canals in the winter. Snowdrifts in the channel of canals are the cause of some difficulties, and their role in creating emergency situations on operating cascades depend on the physiographic conditions of the region and design characteristics of the hydraulic structures. It was established from statistical analysis of the data of field measurements of snowdrift filling of the sections of canals that the surface of the snowdrifts coincides with the line of the axial component of the zero speed of the snow-wind flow. The line of zero speeds is the boundary of snow accumulation in the channel. Maximum snowdrift filling of canal sections will be observed when the area of the eddy zone is filled to the line of the zero speeds. The characteristics of the limits of snowdrift filling of canal sections obtained made it possible to develop relations for calculating the main parameters of snow deposits. The maximum snowdrift filling of the channel along the line of zero speeds is observed only in winters with long snowstorm cycles with a high value of snow transport. For equal volumes of driftage the maximum quantity of snow is deposited in sections located in a deep cut and the minimum in sections located in fill. The practical use of the rapid method of determining snowdrift filling of canal sections enables solving in principle the problem of the expediency of further detailed calculations of probable snowdrift filling and need for planning and designing snow-protection means or mechanized snow removal. (Fish-PTT)
W89-12907

FLOW OVER SIDE WEIRS IN RECTANGULAR AND CIRCULAR CHANNELS.
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.

A. Uyumaz.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 739-746, 1989. 5 fig, 11 ref.

Descriptors: *Hydrodynamics, *Channel morphology, *Side weirs, *Hydraulics, *Weirs, *Channel flow, *Model studies, Flow, Numerical models, Rectangular channels, Circular channels, Discharge capacity, Error analysis.

Numerical models of flow over side weirs in rectangular and circular channels are obtained in diagrammatic form for practical use. It is shown that rectangular channel side weir procedures cannot be used for obtaining approximate water surface profiles along side weirs of circular channels. The length of the side weir in a rectangular channel must be longer than that of the side weir in a circular channel for the same discharge capacity for both of the side weirs. If rectangular channel side weir procedures are used for obtaining the approximate surface profile along side weirs in circular channels, the error in the length of the weirs is 90% for p/D = 0.10, to 10 for pD = 0.90. (Miller-PTT)
W89-13051

HYDRAULIC PERFORMANCE AND CONTROL OF POLLUTANTS DISCHARGED FROM A COMBINED SEWER STORAGE OVERFLOW.
Manchester Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-13052

HYDRAULIC CALCULATION OF THE TRENCH INTAKE OF THE SPILLWAY OF THE KAPSK RESERVOIR.
O. V. Tokmadzhyan, R. G. Martirosyan, V. U. Petrosyan, and P. A. Vartanyan.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 10, p 583-586, April 1989. 5 fig, 10 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 28-30, October 1988.

Descriptors: *USSR, *Design criteria, *Hydraulic design, *Intakes, *Spillways, Cost analysis, Differential equations, Kapsk Reservoir, Construction methods, Rock excavation.

The Kapsk reservoir (Soviet Union) is being constructed on the Akhuryan River for irrigating 17,800 ha and to provide water to the Akhuryan, Ani, Tala, and Artik regions. The emergency spillway of the reservoir comprises a rectangular trench with a three-sided entry of the flow. The length of the trench intake is 46 m; the width at the start of the spillway is 4 m and at the outlet 8 m. The slope of the trench is 0.091. The trench flows into a prismatic discharge canal consisting of three sections of 320 m, 150 m, and 100 m length. A method of calculation was developed for a side-channel spillway in which a computer was employed for the direct integration of the differential equation of nonuniform flow with a variable discharge. Geological conditions uncovered during site investigations suggested that there would be considerable savings if the bottom could be raised in the lower end of the trench intake by 1 m, thus reducing excavation along the entire length of the 320-m stretch of the canal. To do this, however, would result in a reduction of the slope, possibly drowning the trench. Using the previously developed equation it was determined that the maximum discharge of 278.3 cu m/sec could be passed through the spillway even if the bottom of the is raised by 1 m. Because this modification in design was possible, rock excavation requirements were reduced by 4000 cu m, saving 12,000 rubles. Overall, hydraulic investigations contributed to savings of 32,000 rubles on the Kapsk Reservoir project. (Rochester-PTT)
W89-13101

STREAM-DIRECTING WORKS OF THE UPPER POOL OF OVERFLOW SPILLWAYS.
N. A. Petrov, and N. G. Zubkova.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 10, p 587-591, April 1989. 4 fig, 1 tab, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 28-30, October 1988.

Descriptors: *Spillways, *Hydraulic design, *Control flumes, Hydraulic engineering, USSR, Design criteria, Nomograms.

The stream-directing elements in the upper pool are one of the elements of transition of the spillways to a non-overflow earth dam or bank. Their main purpose is to provide a uniform approach of the flow along the spillway front and to protect the upstream slopes of an earth dam and the bottom of the headwater canal from erosion. Among the diversity of stream-directing works, four main types can be distinguished: (1) with a submerging wall, sometimes with a curved free pier, (2) with a flank wall, (3) with a free stream-directing wall extending beyond the limits of the upstream slope of the earth dam, and (4) with oblique walls (when overflow spillways are located in canals). For a preliminary selection of the type of stream-directing works on the basis of hydraulic conditions in the upper pool, the diagram proposed by V. G. Ryl'kov can be employed. This diagram can evaluate the data of investigations of the capacity of extreme outlets, water pressure on the transition walls, and distribution of velocities before the spillway. In the diagram the column is found for the value H/T (H = head at the spillway crest, T = H/P, where P is the height of the sill) and, within it, the line for the ratio B1/T (where B1 is the width of the part of the section spanned by non-overflow structures on the side of the stream-directing works being designed). The Ryl'kov method provides a preliminary assessment, but further details are typically needed to evaluate real schemes. Some of the additional analyses needed are discussed here, including the values of the relative discharge characteristic, nomograms for determining the relative pressure on the bottom, and velocity calculations. (Rochester-PTT)
W89-13102

PROSPECTS OF USING RECONSTRUCTED LOW-HEAD HYDROELECTRIC STATIONS AS HYDROELECTRIC STATIONS/PUMPED STORAGE STATIONS.
For primary bibliographic entry see Field 8C.
W89-13105

SAND TRANSPORT IN TEXAS TIDAL INLET.
For primary bibliographic entry see Field 2J.
W89-13120

INFLUENCE OF VESSEL MOVEMENTS ON STABILITY OF RESTRICTED CHANNELS.
Louisiana Ports and Waterways Inst., Baton Rouge, LA.
For primary bibliographic entry see Field 2J.
W89-13121

REAERATION AT LOW-HEAD STRUCTURES: PRELIMINARY RESULTS.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 5G.
W89-13236

8C. Hydraulic Machinery

NUMERICAL FLOW SIMULATIONS IN FRANCIS TURBINES.
Sulzer-Escher Wyss Ltd., Zurich (Switzerland).
E. Gode, and R. Cuenod.
International Water Power and Dam Construction IWPCDM, Vol. 41, No. 5, p 17-21, May 1989. 4 fig, 9 ref.

Descriptors: *Numerical analysis, *Flow, *Turbines, *Computer programs, *Hydraulic machinery, *Simulation, Mathematical models, Friction, Rotational flow, Profiles, Cavitation, Viscosity, Compressibility.

The results of numerical flow analysis in the runner of a Francis turbine are presented. A three-dimensional Euler computing program was used, which takes no account of friction but calculates the flow on a rotational basis. It is shown that, in many cases, flow phenomena in Francis turbines can be understood only by a complex three-dimensional presentation of numerical results. The flow simulation method presented for use with hydraulic machines can be summarized as follows: it is a finite volume technique; it uses a time stepping method; it has an explicitly formulated numerical scheme; it uses an artificial viscosity; and, it uses an artificial compressibility. As a check on the accuracy of the theoretical results, measurements were carried out on a model Francis turbine using a three-dimensional laser-2-focus measurement technique for comparison with the flow computations. The computed velocity triangles correspond well with the actual flow measurements, both at the runner inlet and outlet. (Doria-PTT)
W89-12403

DEVELOPMENTS IN THE DESIGN OF WATER TURBINES.
Ljubljana Univ. (Yugoslavia). Faculty of Mechanical Engineering.
F. Schweiger, and J. Gregori.
International Water Power and Dam Construction IWPCDM, Vol. 41, No. 5, p 23-26, May 1989. 3 fig, 5 ref.

Descriptors: *Hydraulic machinery, *Turbines, *Design criteria, *Civil engineering, Economic aspects, Cavitation, Surveys, Estimating, Hydraulic design.

The need to exploit the still considerable reserve of water for supply and hydropower is well recognized. To develop hydro energy economically, the correct type of turbine must be selected. The selection of the turbine type presents both economic and design problems. The positioning of the turbine runner is closely associated with the cavitation phenomenon and the extent of civil works. This problem is of particular importance if a selection between two different types of turbines has to be made. Such a situation could occur at the boundary between Francis and Kaplan designs, or if a choice between Kaplan and bulb designs is under consideration. The positioning of the turbine unit and its effect on cavitation is particularly sensitive if an axial turbine is to be selected. Bulb turbines have some advantages over conventional Kaplan turbines because the through flow is, in most cases, larger; therefore a higher specific speed can be achieved. In addition, the use of bulb turbines usually allows for less extensive civil works, thus reducing the cost of the plant. To obtain an overview of the problem, a graph is presented as an up-to-date design approach for all types of water turbines. (Doria-PTT)
W89-12404

SCALE EFFECTS IN BULB TURBINES.
Neyrpic, Grenoble (France).
J. Tadel.
International Water Power and Dam Construction IWPCDM, Vol. 41, No. 5, p 28-30, May 1989. 5 fig, 2 tab, 8 ref.

Descriptors: *Hydraulic machinery, *Turbines, *Scale factor, Model studies, Mathematical analysis, Reynolds number.

A correct determination of scale effect is of great importance for low head turbines, and especially for bulb units. Precise measurements of flow and efficiency are generally impossible, but comparisons of model and prototype power output show a significant discrepancy between the real scale effects and those calculated with classical formulae (such as the Hutton formula) applied to the point of optimal efficiency. Scale effect has been calculated by the empirical method, in a so-called point by point manner. This method gives realistic values, but is not very satisfactory from the theoretical point of view. A procedure giving a correct evaluation of scale effect based on a more accurate technical analysis was therefore pursued. A procedure to evaluate the scale effect for bulb turbine units is presented and examined with regard to

model and prototype tests. These results are to be studied and discussed by the IEC, and compared with other data. It is hoped that this collaboration will lead to a better knowledge of the scale effects in bulb turbines. (Doria-PTT)
W89-12405

KAPLAN AND PROPELLER TURBINE SETTING.
Monenco Consultants Ltd., Montreal (Quebec).
J. L. Gordon.
International Water Power and Dam Construction IWPCDM, Vol. 41, No. 5, p 33-36, May 1989. 2 fig, 2 tab, 16 ref.

Descriptors: *Hydraulic machinery, *Turbines, *Estimating equations, *Costs, Concretes, Powerplants, Economic aspects, Hydroelectric plants.

Data for both horizontal and vertical axis Kaplan and propeller units were analyzed to obtain formulae relating the basic parameters associated with such units. The equations can be used for rapid determination of the basic parameters associated with horizontal axis turbines, namely the throat diameter, setting of the unit, and the powerhouse concrete volume. For such units, most manufacturers are now providing equipment quotations for all the electromechanical components. Using an estimate for the powerhouse concrete, it is thus possible to determine rapidly the cost associated with the powerplant. With knowledge of the relationship between turbine throat diameter and unit setting, it is possible to provide manufacturers with additional data for selection of the unit. For example, if rock at the powerhouse site is low, this could favor selection of a smaller diameter deep set unit. High rock, or dewatering difficulties could favor selection of a large diameter, high set unit. The equations should be confined to preliminary estimates. These equations should not be used to establish a setting for the turbine without the use of model tests to determine turbine sigma, plant sigma, and protection against cavitation. (Doria-PTT)
W89-12406

SOLVING PROBLEMS OF MICRO HYDRO DEVELOPMENT IN NEPAL.
Schweizerische Kontaktstelle Angepasste Technik, Sankt Gallen.
U. Meier, and A. Arter.
International Water Power and Dam Construction IWPCDM, Vol. 41, No. 6, p 9-11, June 1989.

Descriptors: *Nepal, *Hydroelectric power, *Developing countries, *Technology transfer, Mechanical engineering, Turbines, Planning, Maintenance, Decision making.

In 1960, the Swiss technical cooperation agency Helvetas established the first mechanical workshop in Nepal, to create a basic industrial infrastructure. Today, this workshop is a mechanical engineering company with 170 employees and is among the largest enterprises in Nepal, named BYS (Balaju Yantra Shala P (Ltd)). In the early 1970s, the company started to develop a simple water turbine. SKAT, the Swiss Centre for Appropriate Technology, is collaborating with BYS mainly in the field of micro hydro technology and has been involved in turbine development activities over a long period of time. The achievements which have been made to date were possible because of the combined efforts of local industry, government agencies, local planners and contractors, village communities, donor agencies, foreign consultants, and equipment suppliers. Future activities do not seem to be necessarily assured because of the risk of one or several elements in the chain of cooperation failing. The likelihood is that one or several of those involved may not continue to have the capacity, the means, or the motivation to carry on. An account is given of problems which have been encountered, and future developments were recommended. (Author's abstract)
W89-12407

CLASSIFYING AND SELECTING SMALL HYDRO SCHEMES.
Halcrow (William) and Partners, Swindon (England).
E. M. Gosschalk, and M. Bristol.
International Water Power and Dam Construction IWPCDM, Vol. 41, No. 6, p 12-13, June 1989.

Descriptors: *Costs, *Hydroelectric power, *Planning, *Site selection, Classification, Automation, Computers, Dams, Maps, Civil engineering, Indonesia, Energy, Economic aspects, Capital costs, Rate of return.

A system for the classification and selection of hydropower schemes is described, which was devised for the preliminary selection of small hydro projects in eastern Indonesia. The system is thought to be comprehensive, flexible, and practical. It could easily be adapted to larger, similar, or smaller projects in other geographical regions, and is suitable for presentation by computer. It can be used at reconnaissance, prefeasibility, or feasibility levels of evaluation. The system devised is set out in a table, in which 30 characteristics relevant to classification are listed. The measurement of some of these characteristics is inherent in the measurement of others. Of the 30, only 14 or fewer need to be considered in the selection of a site. It should be noted that, to appraise the relative merits of a site, the most promising scheme possible at that site has to be identified in outline and then evaluated. The most promising scheme is taken to be that with the highest net present value. To make a full appraisal of schemes of interest, other or all items may be consulted, some helping to explain the values of others; for example, long access, or transmission lines or geological difficulties would help to explain high cost. On the project for which it was devised, the system led to the selection of six schemes for full feasibility studies from the 15 sites studied at reconnaissance and prefeasibility level. (Doria-PTT)
W89-12408

BELT-DRIVEN STRAFLO UNITS FOR A SMALL LOW-HEAD SCHEME.
Ateliers de Constructions Electriques de Charleroi (Belgium).
X. Coumans, and B. Fontaine.
International Water Power and Dam Construction IWPCDM, Vol. 41, No. 6, p 17-20, June 1989. 4 fig, 7 ref.

Descriptors: *Electrical equipment, *Turbines, *Powerplants, Belgium, Cost analysis, Performance evaluation, Economic aspects, Costs, Maintenance costs, Pumped storage, Dams, Locks, Gates.

The cost-effectiveness of ultra low head hydro stations can be improved by the use of gearing; belt transmission is one of the simplest types of speed increaser. Straflo(R) turbine sets have been connected to belt-driven generators at a 5 MW power station in Belgium. This arrangement results in compact units with high performance reliability and low maintenance costs. The equipment described achieves high performances, and a high level of reliability. It is quiet in operation, and is able to absorb any sudden torque variations. Gear deterioration often results from repeated severe overloading, either caused by shocks from the turbine or from the grid. A belt transmission system requires no special maintenance. The replacement of the belt can be carried out in less than a day, without any dismantling. The mean time between failure of a belt drive is of the same order as that of a gearbox. However, its replacement is much less costly and the delivery time is also much shorter. The Grands Malades power station has been in operation for several months, and has operated satisfactorily. Performance tests have been conducted on the units and the results have exceeded the guaranteed ratings. The belt-transmission has proved to have a number of advantages compared with competitive systems. (Doria-PTT)
W89-12409

MAPPING TECHNIQUES TO CUT SMALL HYDRO COSTS.
Balfour Beatty Engineering Ltd., Kent (England).
For primary bibliographic entry see Field 7B.
W89-12410

TEMPERATURE CONTROL OF THRUST BEARINGS WITH ELASTIC METAL-PLASTIC SEGMENTS.
A. E. Aleksandrov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 7, p 395-402, January 1989. 4 fig, 1 tab, 3 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 7, p 22-27, July 1988.

Descriptors: *Hydraulic turbines, *Hydraulic machinery, *Temperature control, *Friction, *Hydroelectric plants, Thermal conductivity, Elastic properties, Sensors, Electrical equipment, Maintenance, Plastics.

The thrust bearings of turbine-generator units have been modernized with replacement of the babbitted segments by elastic metal-plastic (EMP) segments with a fluoroplastic coating of the friction surfaces, and are presently used at the majority of hydroelectric stations in the Soviet Union. The use of EMP segments in thrust bearings make it possible to considerably increase the operating reliability and to completely eliminate abnormal damages of the bearings. Testing showed that the temperature on the friction surfaces does not substantially change if the areas of the friction surfaces remain approximately equal. The temperature of the body of the EMP segments decreases in comparison with the usual segments by as much as 30 degrees due to the worse thermal conductivity of fluoroplastic. The experience of operation and investigations showed that as a result of the increased life of the EMP segments and their other positive features, the existing temperature monitoring with placement of the sensors 20-30 millimeters from the working surface is sufficient for timely detection of disturbances on the working surface of the segments. In bearings under a specific load of more than 7 MPa the temperature sensors both for visual monitoring and for protection should be installed in all segments, regardless of their number and type of bearing. Measurement and recording of the temperature of the EMP segments from the visual monitoring sensors should be carried out regularly at least three times a day. During the first start after maintenance or inspection the bearing should be continuously monitored until steady values of the temperature are obtained under the full load of the generator. (Fish-PTT)
W89-12464

ADMISSIBILITY OF DEVIATING FROM THE THOMA CRITERION WHEN DESIGNATING THE CROSS-SECTIONAL AREA OF SURGE TANKS.
G. I. Krivchenko.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 7, p 403-409, January 1989. 3 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 7, p 27-30, July 1988.

Descriptors: *Surge tanks, *Hydroelectric plants, *Power head, *Hydraulic engineering, *Hydraulic models, Cross-sections, Diversion channels, Regulated flow, Automation, Electrical equipment, Hydraulic design.

According to the existing practice of designing surge tanks of hydroelectric stations it is required that their cross-sectional area, within the limits of the level for all steady operating regimes of the station, satisfies the Thoma formula, derived from the condition of constancy of power. The relative volume of the tank increases with decrease of length of the diversion system. This characteristic is expressed most substantially at hydrostations having short diversion conduits and a large range of variations of the pool level (upper pool for the upstream tanks and lower pool for the downstream tanks). If the real structure of an automatic regulating system is taken into account, then it is necessary to take into account also the action of the stabilizing devices of the automatic regulators. At large hydrostations electrical central regulators able to automatically maintain the prescribed power of the station independently of the frequency and load of other stations are widely used. Thus

the real operating conditions are approaching the ideal conditions adopted when deriving the Thoma formula, which makes the problem of stability more acute. The problem consists in determining the characteristics of the stabilizing devices with consideration of the existing constraints. An analysis showed that appropriate selection of the parameters of adjusting the system automatically regulating the power of a hydrostation makes it possible to provide stability of its operation and with a smaller cross-sectional area of the surge tank than is required according to the Thoma criterion. The necessary values of the parameters of adjustment are determined by conditions with consideration of the indicated constraints. (Fish-PTT)
W89-12465

EXPERIENCE IN SETTING UP AND OPERATING THE UNITS OF THE INGURI HYDROELECTRIC STATION IN A SYNCHRONOUS CAPACITOR REGIME.
A. Y. Ilin, A. M. Smirnov, V. K. Topuriya, and G. K. Khubua.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 7, p 414-419, January 1989. 3 fig, 1 tab, 2 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 7, p 33-36, July 1988.

Descriptors: *Hydroelectric plants, *Hydraulic turbines, *Pump turbines, *Hydroelectric power, *Hydraulic design, Hydraulic engineering, Hydraulic equipment, USSR.

The Inguri hydroelectric station is equipped with five units capable of being used in a synchronous capacitor (SC) regime. However, on converting the unit to a SC regime the turbine passes into a pumping state, which causes considerable power consumption from the supply line. To convert the units of the Inguri hydrostation to a SC regime, it was suggested to expel the water by compressed air immediately after closing the gate apparatus simultaneously with closing the ball valve, as at other hydrostations. However, in this case lubrication of the rubber seal of the shaft was disrupted and it was scorched. Therefore, here it was necessary to use delivery of air into the pit only after complete closing of the ball valve. When stopping the Inguri unit, the unit at first is converted from a SC regime to a generator regime, and then it is stopped. The implementation of a number of technical measures, the need for which was revealed during adjustment works, provided the possibility of operating the units of the Inguri hydrostation in a SC regime. The experience of adjusting and testing the units of the Inguri hydrostation in a SC regime can be useful for designers determining the need and possibility of using high-head units in this regime. When designing high-head mixed-flow turbines for which a SC regime is provided, it is necessary to take into account the strong pumping action preventing freeing of the runner from water. To provide the minimum consumption of power from the supply during operation in the SC regime, it is necessary to make provisions for a controlled device draining water from the lower zone of the spiral casing for its unloading. For high-head turbines operating in a SC regime, it is necessary to provide a shaft seal unlike the two-row lobed seal, which is not serviceable in the SC regime. (Fish-PTT)
W89-12467

OPTIMIZATION OF THE DISTRIBUTION OF THE LOAD AMONG UNITS OF THE CHIRKEY HYDROELECTRIC STATION.
G. S. Kiselev, and A. A. Kuprik.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 7, p 420-426, January 1989. 5 fig, 2 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 7, p 37-40, July 1988.

Descriptors: *Hydroelectric power, *Hydraulic turbines, *Hydraulic design, *Load distribution, Computer models, Hydraulic engineering, Hydraulic equipment, Head loss, USSR.

Full-scale power tests performed by the absolute method on four units of the Chirkey hydroelectric station at several values of the heads made it possible to obtain the operating characteristics of the units in the range of variation of heads. An analysis of the characteristics obtained shows that they differ among themselves in form, in maximum efficiency with respect to loads and heads in the zone of its location. This indicates the possibility of using individual features of the characteristics for obtaining an effect from optimizing the operating regimes of the units. To determine the effect from various factors of intrastation optimizations of regimes, the most advantageous composition of operating units and optimal distribution of the load among them were calculated by a program using the dynamic programming method for 11 values of the head. It was concluded that optimization of the distribution of the load among units makes it possible to substantially increase the economic efficiency of operation of the Chirkey hydrostation, especially with the limitations on the number and composition of operating units existing at the hydrostation. Realization of the optimal distribution of the load at operating hydrostations with analog group regulation systems is possible after installing at the hydrostations a computer with an input of corrective actions from it to the turbine regulators. (Fish-PTT)
W89-12468

VIBRATION MONITORING AND DIAGNOSTIC SYSTEM OF A TURBINE-GENERATOR UNIT.
V. I. Kolesnikov, V. F. Dolgii, A. N. Chakhirev, and V. E. Semenikhin.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 7, p 427-430, January 1989. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 7, p 41-43, July 1988.

Descriptors: *Hydroelectric plants, *Hydraulic turbines, *Systems analysis, *Vibrations, Automation, Algorithms, Monitoring, Hydraulic equipment, USSR.

Experience in operating units of hydrostations shows that detection of defects in the operation of components at an early stage of occurrence and observation of the dynamics of their development make it possible to reduce the probability and duration of forced downtimes of the unit and to reduce the extent and cost of repairs. In connection with this, the need for routine monitoring of the vibrational state of units by hydrostation personnel arises. For these purposes, a semiautomated vibration monitoring and diagnostic system (VMDS) of the units with realization of the principles of searching for defects occurring and explicit causes of increased vibration was developed and introduced at the Andizhan hydrostation. The VMDS functionally consists of a production type VLN-3 (VKD-3) vibrometer, the complete set of which includes three electrodynamic vibration pickups (VP) with a measuring unit and a vibration diagnostic device UVDG-1. The search for a defect is carried out by means of monitoring and diagnostic algorithms under the condition of exceeding the limit levels of vibration recorded at the main check points by the VLN-3 (VKD-3) vibrometer under the operating regimes of the unit recommended for diagnostic purposes. The use of the VMDS with the use of the UVDG-1 makes it possible to evaluate the vibration state of the unit, to reveal the occurrence of defects in good time, to realize the principle of preventing failures by restoring the base values of the vibration being monitored, and to increase the effectiveness of using the equipment. (Fish-PTT)
W89-12469

OPERATION OF UNITS WITH ADJUSTABLE-BLADE TURBINES CONVERTED TO A PROPELLER REGIME.
V. N. Markin, V. I. Tomilin, and A. Y. Ilin.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 7, p 430-436, January 1989. 2 fig, 1 tab, 3 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 7, p 43-47, July 1988.

Descriptors: *Hydraulic turbines, *Hydroelectric plants, *Seepage control, *Sealants, Lubricants, Oil pollution, Vibrations, Economic aspects, Maintenance, Hydraulic equipment, Power head, USSR.

In recent years cases of the conversion of adjustable-blade (AB) turbines to a propeller regime (PR) have become more frequent at hydroelectric stations. The main reasons for conversion to the PR were (for old turbines) unreliable operation of the runner blade seals owing to physical wear and aging of the materials, which leads to impermissible oil leaks and pollution of the water basin; and (for new turbines) breaking of the blade adjustment mechanism and also inferior sealing rubber or imperfection of the seal itself. The operation of AB turbines in a PR under partial loads and variable heads is accompanied by the loss of generation of electric power, narrowing of the adjustable range, and increased vibrations in transient regimes, idling, and under partial loads. But in some cases the conversion of AB turbines to a PR, according to calculations of specialists at the hydrostations, is economically justified due to a reduction of maintenance expenditures on dewatering the waterway and replacing the runner seals, which exceed losses from the underproduction of electricity. As an experiment, the advisability of using AB turbines in a PR was checked at the Rybinsk station, which has been operating for more than 40 years. It was found that the problem of providing reliable operation of AB turbine runners should be solved by reconstruction of seals of old types by the plants and the use of superior sealing materials. In the case of considerable variations of the head, the variant with discrete regulation of the runner blade angle should be selected. For some power systems it is advisable to have turbines with dual regulation (adjustable-blade) and more simple ones (propeller or mixed-flow), which will make it possible to avoid irrational losses of power in AB turbines at peak hours. (Fish-PTT)
W89-12470

GLACIAL WATERS, CARRIAGE OF SOLID MATERIALS AND DECANTATION IN HYDRO-ELECTRICITY (EAUX GLACIAIRES, TRANSPORTS SOLIDES ET DECANTATION EN HYDRO-ELECTRICITE).
Grande Dixence Societe Anonyme, Sion (Switzerland).
For primary bibliographic entry see Field 8B.
W89-12889

MONITORING THE CLOGGING OF HYDROSTATION TRASH RACKS.
Y. S. Odinets.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 8, p 497-498, February 1989. 1 fig, 2 ref.

Descriptors: *Hydroelectric plants, *Trash racks, *Electric power production, Electric power failure, Clogging, Head loss, Intake gates, Turbines, Model testing, Fall velocity, Flow discharge.

Clogging of hydrostation trash racks by rubbish (timber, ice, etc.) leads to additional losses of the head on the water intake, which causes a reduction of the generation of electricity. At the majority of hydroelectric station the trash racks are cleaned periodically, mainly when clogging of the racks is noted from the loss of power of the turbine unit. Investigations of trash racks on scale models were carried out in a hydraulics laboratory. It was found that the degree of covering the openings of the rack is the determining factor in any case. It is possible to obtain a completely stable relation between the fall, discharge, and covering of the rack. The models showed that it is convenient to monitor the clogging of a rack from the difference of the level on the intake, equal to the difference of the level of the upper pool and readings at the elevations of the piezometer tube installed in the inlet soction of the spiral casing. To monitor the degree of clogging it is necessary to have a system of measuring the pressure drop on the racks of the turbine unit, and to have data of actual measurements of the relation between the turbine power or water discharge, fall on the rack, and degree of clogging of the trash racks. The introduction of the proposed method of monitoring the clogging of trash racks at hydrostations will make it possible to increase the generation of electricity, to consume water more economically, and to increase the reli-

ability of operation of hydropower facilities. (Fish-PTT)
W89-12906

ELIMINATION OF IMBALANCE OF THE ROTOR OF A LARGE TURBINE-GENERATOR UNIT.
A. M. Smirnov, N. G. Platonov, L. G. Meboniya, and S. K. Chanturiya.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 8, p 509-514, February 1989. 5 fig, 1 tab.

Descriptors: *Hydraulic engineering, *Hydraulic machinery, *Hydroelectric plants, *Rotors, Electrical equipment, Mechanical equipment, Mechanical failure, Vibrations, Stress, Strength, USSR.

During the past two years, one of the largest units in modern hydropower engineering in the Soviet Union has shown a tendency toward increased wobbling of the shaft and vibration of the support structures, adversely affecting the operation of the upper and lower generator bearings. Electrical imbalance of the generator rotor was the main cause of the impermissible vibration of the unit, caused by eccentric displacement of the rotor rim relative to the axis of rotation as a consequence of weakening of its wedging and the occurrence in this case of a unilateral rotating force of magnetic stress. It is advisable to carry out additional wedging of the rotor rim on newly installed generators after accruing a certain number of hours under a load, which will reduce the probability of a change in the shape of the rotor with displacement of its center relative to the axis of rotation. Despite the insignificant eccentricity of the rotor relative to the axis of rotation, it causes a high vibration of the support part due to the occurrence of a rotating axis of magnetic stress. Frequent damage of generator bearings occurs not only from wobbling of the shaft, but also from their design imperfection. The thickness of the regulating wedge does not correspond to the gap being regulated. As a result of this, it is necessary to install metal shims of considerable thickness, which increases the work of the bearings and hinders their operation. Additionally, the stop element welded to the bearing housing is a weak link. With improper installation of the sealing elements of the oil bath around the shaft of the unit, the danger of unilateral catching of the seal on the shaft occurs, and must be taken into account when overhauling units. (Fish-PTT)
W89-12910

PROSPECTS OF USING RECONSTRUCTED LOW-HEAD HYDROELECTRIC STATIONS AS HYDROELECTRIC STATIONS/PUMPED STORAGE STATIONS.
V. I. Vissarionov, V. V. Elistratov, and S. I. Potashnik.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 10, p 601-603, April 1989. 3 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 38-40, October 1988.

Descriptors: *USSR, *Turbines, *Pumped storage, Pump turbines, Bulb turbines, Low-head hydroelectric plants, Performance evaluation, Peaking capacity, Dnieper River, Design criteria.

To provide more flexible power supplies in an era when nuclear and large condensing steam power plants provide the basis of electric supply, conversion of hydroelectric stations (HES) to HES/pumped-storage stations (PSS) has been proposed. In this connection, the Leningrad Polytechnic Institute and the Middle Dnepr hydroelectric station cooperated on an investigation of the use of horizontal bulb turbine units in a pumping mode. The zone of optimal operation in a pumping regime does not coincide with the zone of the maximum efficiency in turbine regimes, with respect to which the runner was selected: the entire zone of the pump regimes is shifted into the region with lower efficiency values, particularly when operating in the range of heads above the design. To improve the operating characteristics of the block of the HES in HES/PSS regime, it is expedient to develop special runners capable of providing acceptable performance in both regimes. Reversible axial-flow pumps with adjustable blades intended for installation on several units of the Kiev HES presently are being developed. The use of blade systems similar to those of pumps gives good results. To provide satisfactory cavitation indices in the pump regime a runner with a larger hub-to-tip ratio than that of turbine runners is required. The introduction at a HES of HES/PSS regimes requires the use of runners with a hub-to-tip ratio greater than 0.35 D sub 1. This leads to some decrease in power in the turbine regime, but with an increase in head of the HES due to pumping, this decrease can be largely compensated. Depending on the volumes of water being pumped, the increase of power due to an increase of head in the turbine regime can amount to 5-15%. (Rochester-PTT)
W89-13105

8D. Soil Mechanics

SEISMIC STABILITY OF THE HYDRAULIC-FILL DAM OF THE KAIRAKKUM HYDROELECTRIC STATION.
For primary bibliographic entry see Field 8A.
W89-13099

CALCULATION OF THE STRESS-STRAIN STATE OF EARTH STRUCTURES WEAKENED BY LOW-STRENGTH INTERLAYERS.
For primary bibliographic entry see Field 8A.
W89-13103

8E. Rock Mechanics and Geology

INVESTIGATION OF THE STABILITY OF BOREHOLE BENCH MARKS IN THE LOWER POOL OF THE BRATSK DAM.
For primary bibliographic entry see Field 8A.
W89-12473

ELIMINATION OF COFFERDAMS WHEN CONSTRUCTING HYDROELECTRIC STATIONS.
For primary bibliographic entry see Field 8H.
W89-12900

THERMAL STRESS STATE OF AN UNDERGROUND POWERHOUSE ROOF DURING CONSTRUCTION AND OPERATION.
G. L. Khesin, G. S. Vardanyan, V. N. Savotyanov, A. S. Isaikin, and L. Y. Frishter.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 8, p 468-475, February 1989. 6 fig, 14 ref.

Descriptors: *Hydroelectric plants, *Thermal stress, *Rock mechanics, *Stress analysis, Reinforced concrete, Load distribution, Elastic properties, Construction methods, Thawing, Compressive strength, USSR.

The excavation of the machine room of a hydroelectric station located in perennially frozen rock uses technology which causes seasonal fluctuations of the air temperature in the hall. This leads to time-varying thermal stresses in the reinforced concrete roof and rock, as shown by a comparison of the results of the effect of the main loading factors obtained with the use of numerical and experimental methods in a linearly elastic formulation. An investigation was performed in a stress research problems laboratory in Moscow, and included calculation of the transient temperature fields in the roof and adjacent rock and selection of the time at which temperature distribution is least favorable from the viewpoint of the stress state of the roof; determination of the thermoelastic stresses around the area during the construction period with consideration of the effect of a tectonic fracture in the space above the roof and for the operating period with consideration of thawing of the frozen rock. It was concluded that forced ventilation accompanying the driving of underground pilings leads to substantial temperature fluctuations of the roof surface and to the occurrence of thermal compressive stresses in the roof of the powerhouse. A tectonic fracture passing near the roof at the initial time of thawing of the mass promotes the occurrence of stress concentration in the roof. The temperature regime of the surrounding frozen rock mass during hydrostation operation stabilizes within 40-50 years of the constant thermal effect from the machine hall. Thawing of frozen rocks in the operating period of the hydrostation is favorable for the stress state of the powerhouse. (Fish-PTT)
W89-12901

CONSIDERATION OF THE ELASTOPLASTIC BEHAVIOR OF CONCRETE DAMS AND ROCK FOUNDATIONS IN CALCULATIONS WITH THE USE OF THE FINITE-ELEMENT METHOD.
M. G. Zertsalov, and V. V. Tolstikov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 8, p 487-491, February 1989. 3 fig, 5 ref.

Descriptors: *Stress analysis, *Rock mechanics, *Finite element method, *Materials engineering, Boundary conditions, Temperature effects, Strength, Concrete technology, Dam foundations, Seepage, Expansion, Plasticity, Mathematical models, Elastic properties, Foundation failure.

The finite element method (FEM) of rock mechanics makes it possible to solve problems in a two-dimensional and three-dimensional formulation with consideration of various boundary conditions, force and temperature effects, and the inhomogeneity and strength properties of the material. At present the FEM is perhaps the only method by means of which it is possible to take into account in calculations of concrete dams on rock foundations, large cracks, and fractures, the interaction of the structure and the foundation, the volume character of the application of seepage forces, and the formation of regions of expansion and plastic deformations. A mathematical model is examined which makes it possible, within the scope of the two-dimensional problem, to take into consideration the total diagram of the behavior of concrete and rock in a state of combined stress by the FEM, and reflects the behavior of an elastoplastic medium. The use of the model made it possible to obtain a practically complete coincidence of the position of the calculated and experimental path of the crack in the entire range of applied loads up to reaching the limit of the bearing capacity. The results of the calculations as a whole correspond to the results of field investigations of shear of rock pillars and confirmed the picture of failure, obtained on the basis of their analysis. (Fish-PTT)
W89-12904

SYSTEMATIZATION OF DAM DEFORMATIONS ON THE BASIS OF RESULTS OF GEODETIC MEASUREMENTS.
A. A. Karlson.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 8, p 491-496, February 1989. 2 fig, 4 tab, 14 ref.

Descriptors: *Hydroelectric plants, *Geological surveys, *Structural engineering, *Foundation failure, *Dam foundations, Reservoirs, Surveys, Deformation, Concrete dams, Gravity dams, Arch dams, Earth dams.

Observations by geodetic methods at hydroelectric developments are among the most essential on-site observations in the overall complex, and have expanded our notions about the settlement and displacement of dams and their foundations, making it possible to reveal and evaluate a number of causes of deformations not known or not taken into account in calculations, since their effect on the overall result was considered negligibly small. They include, for example, the convergence or divergence of the banks at the site during filling of the reservoir. From geodetic measurements it is possible to obtain more diverse information about the causes and character of deformation processes. In particular, from the total deformations it is possible to isolate components caused by different factors. The greatest differences between the calculated and measured settlements and horizontal

displacements are related to the foundations, where only approximate deformation characteristics are obtained from surveys. Knowledge of the causes of deformations and their approximate numerical characteristics and of the regularities of the temporal changes in the latter enable a more valid solution of still another problem: the planning of observations at new hydrologic developments and determination of the composition, methods, and accuracy of the measurements. Certain causes of deformations and the vertical and horizontal displacements caused by them are examined for the following structures: dam foundations, concrete gravity dams, arch dams, and earth dams. (Fish-PTT)
W89-12905

PROVISION OF RELIABILITY AND ECONOMY OF MODERN CONCRETE-FACED ROCK-FILL DAMS.
For primary bibliographic entry see Field 8A.
W89-13098

ARPA-SEVAN TUNNEL.
For primary bibliographic entry see Field 8A.
W89-13100

STRENGTH OF REINFORCED-CONCRETE RETAINING WALLS.
V. B. Nikolaev, S. Y. Gun, S. E. Lishichkin, and O. B. Lyapin.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 10, p 616-621, April 1989. 4 fig, 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 54-58, October 1988.

Descriptors: *Reinforced concrete, *Retaining walls, *Stress analysis, Cracks, Theoretical analysis, USSR, Numerical analysis, Model studies, Strength, Standards.

Recent onsite observations of reinforced-concrete retaining structures in the Soviet Union and abroad have demonstrated deviations between design premises and primary intense cracking not predicted by standard methods. A method of estimating the need for reinforcement in concrete walls is described. Theoretical investigations of the stress state were carried out using the finite-element method. The stress state of a concrete lock wall was determined with cracks along the block joints, with an inclined crack, and with transverse steel in place. The stress state under load (bending moment and transverse force) was determined. Numerical and analytical approaches to these determinations were compared. A formula was development for determining the amount of reinforcing steel needed for each meter of length based on placing transverse steel whenever the principal tensile stresses exceed the tensile strength of the concrete. Thus, the calculation of the transverse steel reduces not to finding an unfavorable rectilinear inclined section and distribution of steel in the entire calculated zone, but to calculating the necessary cross section of the reinforcement for each meter of structure length, including the structural zones. The present approach was examined numerically, by tests with reinforced-concrete models, and by tests on larger scale reinforced-concrete members. A satisfactory agreement between experimental and calculated results was obtained. The new method does not contradict the existing Soviet standard SNiP 2.06.08-87. In practice the use of this method is rather simple to use in engineering practice for reliable determination of the amount of steel needed in critical members of hydraulic and other structures. (Rochester-PTT)
W89-13109

HISTORY OF THE HYDROGRAPHY OF HUNGARY AND THE CARPATHIAN BASIN DETERMINED BY LARGE-SCALE TECTONICS.
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 2J.
W89-13310

8F. Concrete

POLYMER-CEMENT SHOTCRETE AT THE CONSTRUCTION OF THE DANGARA HYDRAULIC TUNNEL.
V. V. Rukin, N. V. Dmitriev, V. E. Kuznetsov, and A. D. Sotnikov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 7, p 390-394, January 1989. 1 fig, 1 tab, 9 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 7, p 18-22, July 1988.

Descriptors: *Tunnel construction, *Tunnel linings, *Gunite, *Concrete technology, *Hydraulic engineering, Polymers, Concrete mixes, Concrete testing, Concrete additives, Tunneling, Weathering, Mineralization, Saline water, Sandstones, Geologic fractures, Protection, USSR.

The Dangara hydraulic tunnel is being constructed under complex mining and geological conditions due to the specific nature of the properties and composition of the surrounding rocks, which are composed of sandstones with interlayers of siltstones, argillites, and sandy clays. The mass is broken by a joint system into blocks having variations of mineralization due to dilution of deep saline waters by atmospheric waters penetrating along fractures outcropping on the surface. In a natural occurrence the rocks have considerable strength in a chunk, whereas upon contact with atmospheric agents they rapidly weather and disintegrate. During tunneling it was necessary to immediately cover them with a protective layer against weathering. Effective support of the underground workings can be accomplished by means of shotcrete modified with latex. The use of polymer-cement shotcrete (gunite) is especially effective in rocks subjected to erosion under the effect of the atmosphere and natural moisture content of the air. Gunite has a number of advantages in comparison with ordinary shotcrete: increased elasticity, high impermeability and adhesiveness to rocks and concrete, resistance to corrosive effects, nontoxicity of the polymer used, and simplicity of the technology of adding latex to the coating material. The addition of polymer makes it possible to reduce the thickness of the coating by at least half while preserving the strength and operating characteristics of the support, which provides a high cost-effectiveness of using polymer-cement shotcrete. The wide use of highly effective polymer-cement compositions using a base of synthetic latex in hydrotechnical construction is recommended. (Fish-PTT)
W89-12463

USE OF ANALOG VALUES OF RHEOLOGICAL PROPERTIES OF CONCRETE.
I. F. Blinov, E. M. Mirzak, and I. R. Galperin.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 7, p 442-446, January 1989. 1 fig, 2 tab, 4 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 7, p 57-59, July 1988.

Descriptors: *Concrete dams, *Stress analysis, *Strain, *Concrete testing, *Hydraulic engineering, Elastic properties, Strain gages, On-site tests, Arch dams, Electrical equipment, Hydroelectric plants, Creep, Rheology, USSR.

Assurance of safe operation of concrete dams requires special attention devoted to monitoring their stress-strain state, using the strain-gage method in on-site observation practice. The physical and mechanical characteristics of concrete are determined by testing concrete samples under a load in the laboratory or in elements isolated and loaded directly in the structure. To determine the possibility of using analog values of the elastoplastic characteristics of concrete, the effect of a change in their values on the stresses being calculated was studied with two series of stress calculations in which the values of the modulus of elasticity and specific creep of concrete were varied. The physical and mechanical characteristics of concrete of the dams of four hydrostations, a reservoir dam, and an arch dam were used as a data base. The normal stresses during the ten-year period of observations were calculated from strains measured by transducers on the arch dam, characteristic for various types of concrete structures. In the case of large differences of the analog values of the modulus of elasticity from the design value, it is necessary to determine it experimentally. For a variation of the values of the limiting specific creep in the lower range and for a level of stresses up to 7 MPa, the error in calculating the stresses does not exceed 9%. A comparison of the analog values and first experimental data of the physical and mechanical characteristics of concrete in a dam under construction will enable making a decision about the expediency of conducting further tests to determine the rheological properties of the concrete. (Fish-PTT)
W89-12472

CONSIDERATION OF THE ELASTOPLASTIC BEHAVIOR OF CONCRETE DAMS AND ROCK FOUNDATIONS IN CALCULATIONS WITH THE USE OF THE FINITE-ELEMENT METHOD.
For primary bibliographic entry see Field 8E.
W89-12904

PHYSICAL AND MECHANICAL PROPERTIES OF CONCRETE OF THE MOSCOW CANAL LOCKS.
I. E. Pukhov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 8, p 502-505, February 1989. 3 tab, 2 ref.

Descriptors: *Locks, *Concrete technology, *Concrete testing, *Reinforced concrete, Mechanical failure, Corrosion, Deterioration, Compressive strength, Strength, Tensile stress, Variation coefficient, Elastic properties, Drilling samples, Drilling equipment, Cores, USSR, Canals, Moscow Canal.

The locks are the largest concrete structures on the Moscow Canal, in operation since 1937. During 50 years of operation, the surfaces of the concrete walls of the lock chambers were subjected to considerable destruction with the formation of cavities, cracks, and sloughs with exposure of the corroded reinforcement. During the time of operation of the canal, the compressive strength of the mass of concrete of the locks increased in comparison with the design by two to two-and-a-half times. At the same time, zones are found in the massive elements of the locks where the strength of the concrete is less than the design. The cleavage tensile strength of the concrete relative to the compressive strength is 8-11%. The water absorption of the concrete of the canal locks are distinguished by considerable inhomogeneity. The coefficient of variation of the compressive strength of the concrete reaches 40% and of the tensile strength reaches 42%. The average value of the modulus of elasticity of the concrete, equal to 24,800 megapascals, corresponds to that recommended by the building code for the corresponding concrete grade with respect to compressive strength. Drilling holes in concrete with a strength of 10 megapascals and less by means of hard-metal bits does not provide preservation of the cores. To obtain cores in concrete of the indicated strength, drilling should be carried out only with diamond bits. (Fish-PTT)
W89-12908

ANALYSIS OF THE BEHAVIOR AND STRENGTHENING OF LOCK DOCK WALLS.
For primary bibliographic entry see Field 8A.
W89-12909

EFFECTS OF CONCRETE CRACKING ON THE EARTHQUAKE RESPONSE OF GRAVITY DAMS.
Texas Univ. at Austin. Dept. of Civil Engineering.
L. M. Vargas-Loli, and G. L. Fenves.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 18, No. 4, p 575-592, May 1989. 12 fig, 20 ref. NSF Grant ECE-8504459.

Descriptors: *Gravity dams, *Concrete dams, *Dam design, *Earthquake engineering, *Structural engineering, *Tensile stress, *Hydrodynamics, Mathematical analysis.

Tensile stresses exceeding the tensile strength of concrete can develop in concrete dams subject to earthquake ground motion. A study examined the earthquake response of concrete dams including tensile cracking of the concrete. The interaction between the dam and the compressible water was included in the analysis using a mathematical procedure for computing the non-linear dynamic response of fluid-structure systems. The crack band theory was used to model tensile cracking with modifications to allow for the large finite elements necessary for dam analysis. The earthquake response of a typical gravity dam monolith showed that concrete cracking is an important non-linear phenomenon. Cracking was concentrated near the base of the dam and near the discontinuities in the face slope. The extensive cracking, which develops due to ground motion of maximum credible earthquakes, may affect the stability of dams during and after strong earthquakes. (Author's abstract)
W89-13035

PROVISION OF RELIABILITY AND ECONOMY OF MODERN CONCRETE-FACED ROCK-FILL DAMS.
For primary bibliographic entry see Field 8A.
W89-13098

USE OF MUSHY CONCRETES IN CONSTRUCTION OF THE INGURI HYDROELECTRIC STATION.
G. T. Mikeladze, A. I. Daneliya, and R. V. Gakhariya.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 10, p 598-600, April 1989. 4 tab, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 36-38, October 1988.

Descriptors: *USSR, *Dam construction, *Concrete techniques, *Arch dams, Concrete additives, Construction techniques, Inguri Hydroelectric Station, Mushy concrete, Tunnels, Underground powerplants.

The Inguri hydroelectric station (Soviet Union) includes a high arch dam, deep-water intake, pressure tunnel, and an underground powerhouse complex. When constructing the powerhouse complex, one of the most complex operations was concreting the annulus of the inclined conduit, which consisted of five independent lines located at a distance of 23.6 m from one another, the length of the inclined part is 451.1 m, the slope angle to the horizon is 30-35 deg, and the annulus was 0.25-0.5 m, with an average diameter of excavation of 6.6 m. Filling of the annulus by means of fluid concrete (cone slump 8-20 cm) with subsequent packing was ruled out because of the small space available and the hazardous laboring environment. Concreting of the annulus of the underground conduits, spiral casings, and heavily reinforced and difficult-to-access structures with mushy concrete by gravity feed of the concrete mix into the structures, which provided the required strength, was undoubtedly an effective means of solving the problem. The main characteristics of the selected concrete compositions (mushy grades M150 and M250) were: cone slump immediately after preparation 22-24 cm; water/cement ration 0.59 and 0.60, respectively; relative content sand in the aggregate mixture 0.47 and 0.45, respectively; and water impermeability 16. The use of a complex additive consisting of the plasticizer sulfite yeast liquor, an air-entraining wood chemical additive, and the set retarder feed molasses proved most effective when producing highly fluid (mushy) concrete mixes. The complex additives substantially improve cohesiveness, workability, and keeping qualities (with respect to fluidity), and also considerably reduce segregation during placement in the structures being concreted. The use of mushy mixtures reduces labor expenditures of concreting geometrically and technologically complex structures, improves working conditions, and shortens the construction time. (Rochester-PTT)
W89-13104

EVALUATION OF THE CONCRETE QUALITY OF THE SAYANO-SHUSHENSKOE DAM FROM CORES.
V. M. Vlasov, L. M. Deryugin, V. I. Veretyushkin, and A. S. Moiseenko.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 10, p 604-607, April 1989. 1 fig, 2 tab, 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 41-43, October 1988.

Descriptors: *USSR, *Concrete testing, *Dam construction, Testing procedures, Standards, Sayano-Sushenkoe Dam, Concrete dams, Comparison studies, Strength.

The methods employed for evaluation of concrete quality from cores taken at the Sayano-Sushenskoe Dam (Soviet Union) are discussed. Conversion factors were developed to relate characteristics in concrete samples obtained from vertical drilling with those of standard specimens. The effect of core storage conditions on strength also was evaluated. Over the course of the years from 1973 through 1982, the actual average cube strength of the control specimens (moist storage chamber, 180 days) was 34 MPa, with average coefficient of variation of 0.135. The reduced cube strength of concrete of grade 300 at an age of 180 days will be 38.6 MPa, with a coefficient of variation of 0.161. A comparison of these figures showed that, with an increase of the average strength of the concrete being placed and gaining strength in the structure on average by 1.13 times, its coefficient of variation will be 1.19 times in comparison with the control specimens made under laboratory conditions. (Rochester-PTT)
W89-13106

STATIC BEHAVIOR OF THE SAYANO-SHUSHENSKOE DAM IN THE LAST STAGES OF FILLING THE RESERVOIR.
For primary bibliographic entry see Field 8A.
W89-13107

8G. Materials

DRAINAGE SYSTEM PERFORMANCE AFTER 20 YEARS.
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 3F.
W89-12424

8H. Rapid Excavation

ELIMINATION OF COFFERDAMS WHEN CONSTRUCTING HYDROELECTRIC STATIONS.
S. A. Davydov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 8, p 463-467, February 1989. 5 fig, 3 ref.

Descriptors: *Hydroelectric plants, *Cofferdams, *Explosions, *Dam construction, Construction methods, Construction joints, Rock mechanics, Backwater, Vietnam.

At every hydroelectric construction site there are cofferdams enclosing the foundation pit, diversion streams, among others. In the overwhelming majority of cases the water is ponded on one side of the cofferdam. Cofferdams can be made of fill, rockfill, and rock. To eliminate the cofferdam at the end of the construction project by an excavating explosion, the method of linear charges has begun to be used more widely lately. At the construction of the Hoa-Binh (Vietnam) hydrostation development seven cofferdams were blasted by this method. In the case of loosening blasting of cofferdams with subsequent excavator mucking of the rock mass, the use of the blasthole charge method is most effective. In this case, when blasting rock-pillar-cofferdams having the III-IV category of jointing, it is necessary to use the parameters calculated for fine crushing of the rock mass. In the case of excavating blasting of cofferdams, linear charges are being most popular, and can sometimes be simulated by rows of adjacent large-diameter holes or can be replaced by chamber charges. In the case of blasting with a one-sided backwater, the explosion of underwater charges provides complete directivity of ejection. If ejection should be directed toward the backwater, these charges should be detonated first. (Fish-PTT)
W89-12900

8I. Fisheries Engineering

ALGAL PICOPLANKTON PRODUCTION AND CONTRIBUTION TO FOOD-WEBS IN OLIGOTROPHIC BRITISH COLUMBIA LAKES.
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
For primary bibliographic entry see Field 2H.
W89-12316

PROMISING DESIGNS OF FISHWAYS.
A. S. Barekyan, B. S. Malevanchik, and M. A. Skorobogatov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 7, p 384-388, January 1989. 5 fig, 7 ref. Translated from Gidrotekhnicheskoe Stroitelstvo, No. 7, p 15-17, July 1988.

Descriptors: *Fisheries, *Hydraulic engineering, *Hydraulic structures, *Fish passages, *Spawning, Fish guiding, Fish management, Fish conservation, Hydraulic design, Design criteria, Hydrologic systems, Hydrologic regime, Commercial fishing.

The designing of fishways is based on the location of the fishway in the system of hydrologic development and optimization of the hydraulic regimes in various zones: in the fishway, in the fish attraction zone in the lower pool of the hydrologic development, in the fish release zone in the upper pool, etc. The effectiveness of a fishway largely depends on its design and on the technological scheme of passage of the fish to spawning grounds. To eliminate negative aspects of the operation of existing fishways, research and development studies were carried out to develop new promising designs and technological schemes of attracting, holding, and conveying spawners from the lower to the upper pool of a hydrologic development. The realization of these designs will make it possible to increase the number of fishes being passed to spawning grounds, to reduce injury during their conveyance from the lower to the upper pool, and to reduce the number of downstream migrants that pass into the upper pool. The main group of developments is aimed at increasing the duration of active attraction of fishes, i.e., attraction at speeds close to the optimal, by changing the technology of releasing fish into the upper pool. One of the possible ways of increasing the productivity of a fishway is to continuously attract fish with a constant current speed at the exit of the fish-holding chute. Also effective is to replace the exiting stimulating devices with netting requiring a reduction of the current speed in the fish-holding chutes during its movement by devices using an electrical field for fish stimulation. Use of these fishway designs will make it possible to increase the passage of spawners to spawning grounds and thereby to increase the number of valuable commercial fish species in inland water bodies. (Fish-PTT)
W89-12461

EVOLVING WATER QUALITY IN A COMMON CARP AND BLUE TILAPIA HIGH PRODUCTION POND.
New Alchemy Inst., East Falmouth, MA.
For primary bibliographic entry see Field 2H.
W89-12592

DEATH IN THE SEA: A FISHERMAN'S PERSPECTIVE.
Finnish Game and Fisheries Research Inst., Helsinki. Fisheries Div.
For primary bibliographic entry see Field 5C.
W89-12643

GLIMMER OF HOPE FOR STREAM FISHERIES IN MISSISSIPPI.
Mississippi State Univ., Mississippi State. Dept. of Wildlife and Fisheries.
D. C. Jackson, and J. R. Jackson.

Fisheries (Bethesda), Vol. 14, No. 3, p 4-9, May/June 1989. 1 fig, 3 tab, 27 ref.

Descriptors: *Fisheries, *Stream fisheries, *Mississippi, *Fish stocking, Channeling, Flood control, Rivers, Yazoo River Basin.

The composition of fish stocks in the Yalobusha River are documented and the extent to which these stocks consisted of exploitable fisheries resources is determined. Using these data as a foundation, a case is built for protecting the Yalobusha River basin and other streams throughout the Yazoo River basin. Channelization and related flood control works have severely affected most stream fisheries in the Yazoo river basin of western Mississippi. However, recovery processes appear to be quite advanced in some of these streams. A prime example is the Yalobusha River, which is one of the principal tributaries of the Yazoo River. The Yalobusha River was channelized in 1953 but stock assessments conducted in the 1980s have documented excellent fisheries in this system. Exploitable commercial and sport fishes collectively contributed 63.5-78.0% to the biomass of hoop net samples collected during 1986-88. Renewed dredging, clearing, and snagging of the Yalobusha River and other headwater streams in the Yazoo River basin are components of an overall Yazoo River basin flood control plan. These operations, if carried out, would impact the region's stream fishery resources once again. A recent statewide survey indicated that most Mississippi anglers prefer to fish in streams. Strong public opposition to the flood control project has resulted in a federal court order to stop operations on the Yalobusha River pending a comprehensive review and reevaluation. (Miller-PTT)
W89-12746

EPISODIC FISH KILLS IN AN ACIDIFIED SALMON RIVER IN SOUTHWESTERN NORWAY.
Direktoratet for Vilt og Ferskvannsfisk, Trondheim (Norway). Fish Research Div.
For primary bibliographic entry see Field 5C.
W89-12747

IMPACT OF WATER QUALITY ON FISH PRODUCTION BASED ON EGYPTIAN AND ISRAELI PRACTICES.
Hebrew Univ. of Jerusalem (Israel). Graduate School of Applie Science and Technology.
B. Fattal, A. M. Eisawy, A. Dotan, H. I. Shuval, and K. H. Mancy.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 27-33, July 19, 1989. 2 fig, 1 tab, 15 ref.

Descriptors: *Aquaculture, *Fish farming, *Wastewater utilization, *Water quality, *Escherichia coli, *Aeromonas, *Public health, Israel, Egypt, Fish ponds, Wastewater dilution, Reservoirs.

An Israel-Egypt-USA collaborative project studied the health risks and technological options for fish grown in polluted waters. The fish were grown in aquaculture with or without wastewater-enrichment. The study included one effluent polishing pond, two fish ponds and two water reservoirs. The fish stock in the ponds and reservoirs consisted mainly of tilapia (usually hybrids of Sarotherodon niloticus x S. aureus). The results of Israeli and Egyptian studies indicated that, on the average, the yields for wastewater aquaculture were higher than the yields without wastewater. However, the Egyptian study showed that in areas with inadequate dilution of wastewater by freshwater near to a sewage outfall, there were negative effects on fish production. Microbiological assays (Escherichia coli and Aeromonas) of water and fish tissues indicate that the Aeromonas counts were high in the water as well as in the fish tissues. The bacterial count was higher in the digestive tract than in the water in which the fish were grown. In most cases only Aeromonas was detected in muscles. There was no difference between wastewater-enriched and nonwastewater aquacultures for both E. coli and Aeromonas concentrations in fish tissues. (Author's abstract)
W89-12782

MICROBIOLOGICAL ASPECTS OF FISH CULTURED IN WASTEWATERS: THE SOUTH AFRICAN EXPERIENCE.
Council for Scientific and Industrial Research, Pretoria (South Africa). Div. of Water Technology.
J. L. Slabbert, W. S. G. Morgan, and A. Wood.
Water Science and Technology WSTED4, Vol. 21, No. 3, p 307-310, July 19, 1989. 1 tab, 12 ref.

Descriptors: *Water reuse, *Aquaculture, *Fish farming, *Wastewater utilization, *Coliforms, *Salmonella, *Bacteriophage, *Public health, Stabilization ponds, Tissue analysis.

Health risks associated with the utilization of wastewater for fish production were studied by investigating the possible incorporation of pathogenic microorganisms into fillets of fish. Fish were cultured in cages in stabilization ponds at two municipal wastewater treatment facilities, and in a flow through and recirculating system receiving humus tank effluent. Water and fish were analyzed for total and fecal coliforms, Salmonella and coliphages. Even though high numbers of fecal coliforms (200,000/100 ml) and coliphages (1.2 million/100 ml) were detected in the wastewater, and in some instances Salmonella were isolated, none of these microorganisms were found in fish fillet. Results of the study indicate that fillets of fish grown in such wastewater pond systems are microbiologically safe for human consumption, provided that simple precautions are maintained in food handling and processing, and that ponds are restricted to domestic wastes. (Author's abstract)
W89-12830

OBSERVATIONS ON FEEDING RELATIONSHIPS BETWEEN FISH PREDATORS AND FISH ASSEMBLAGES IN A MEDITERRANEAN STREAM.
Barcelona Univ. (Spain). Dept. of Animal Biology.
For primary bibliographic entry see Field 2H.
W89-12915

FISH POPULATION DYNAMICS IN THE RIVER FROME, DORSET.
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
For primary bibliographic entry see Field 2H.
W89-12916

USE OF NICHE BREADTH AND PROPORTIONAL SIMILARITY IN FEEDING TO STIPULATE RESOURCE UTILIZATION STRATEGIES IN FISH.
Herbert H. Lehman Coll., Bronx, NY. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W89-12956

FACTORS INFLUENCING THE ABUNDANCE OF BROOK TROUT (SALVELINUS FONTINALIS) IN FORESTED MOUNTAIN STREAMS.
Wyoming Cooperative Fishery and Wildlife Research Unit, Laramie.
For primary bibliographic entry see Field 2H.
W89-12957

TOLERANCE LEVEL AND HISTOPATHOLOGICAL RESPONSE OF MILKFISH (CHANOS CHANOS) FINGERLINGS TO FORMALIN.
Southeast Asian Fisheries Development Center, Iloilo (Philippines). Aquaculture Dept.
E. R. Cruz, and C. L. Pitogo.
Aquaculture AQCLAL, Vol. 78, No. 2, p 135-145, May 1989. 10 fig, 1 tab, 24 ref.

Descriptors: *Fish farming, *Milkfish, *Pesticides, *Antiparasitic agents, *Formalin, *Toxicity, Chanos, Gills, Liver, Kidneys.

Static 96-hr. bioassays were conducted on milkfish fingerlings (average weight 6 g) with formalin at concentrations ranging from 50-500 ppm. The 24-, 48-, 72-, and 96-h medial lethal concentration values (LC50) were 322, 260, 241 and 232 ppm formalin, respectively. Histological analyses of gills, liver, and kidney tissues revealed significant pathological changes even with the sublethal concentrations. The intensity of cell damage increased with increasing concentration and exposure to formalin. Formalin treatments caused hyperplasia, epithelial separation, and necrosis in the gills; cloudy swelling, hemorrhage, deposition of pigments, and necrosis in liver parenchyma; and degeneration of renal tubules. Partial recovery of tissues was observed in fish after 10 days in formalin-free seawater. (Author's abstract)
W89-13005

RESISTANCE TO OZONE OF ZOOSPORES OF THE THRAUSTOCHYTRID ABALONE PARASITE, LABYRINTHULOIDES HALIOTIDIS (PROTOZOA: LABYRINTHOMORPHA).
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
For primary bibliographic entry see Field 5F.
W89-13006

CADMIUM IN MYTILUS SPP.: WORLDWIDE SURVEY AND RELATIONSHIP BETWEEN SEAWATER AND MUSSEL CONTENT.
Institut Francais de Recherche pour l'Exploitation de la Mer, Nantes.
For primary bibliographic entry see Field 5B.
W89-13041

AQUACULTURE AND COASTAL ZONE MANAGEMENT IN BANGLADESH.
Universidad de Oriente, Cumana (Venezuela). Inst. Oceanografico.
A. K. M. Bashirullah, N. Mahmood, and A. K. M. A. Matin.
Coastal Management CZMJBF, Vol. 17, No. 2, p 119-127, 1989. 1 fig, 18 ref.

Descriptors: *Coastal zone management, *Developing countries, *Resources development, *Environmental effects, *Bangladesh, *Aquaculture, Coastal waters, Shellfish farming, Agriculture, Development, Shrimp, Interagency cooperation, Human population, Flood damage, Farming, Reforestation, Levees, Environmental protection.

A brief survey is given of the present status of brackish water shrimp culture and its increased importance in the economy of Bangladesh. The high and increasing population density is forcing people to engage in agriculture and aquaculture in low lying coastal areas where they are exposed to cyclones and tidal floods. Colonization of these areas has, however, led to deforestation and other adverse effects on the ecosystem. A policy of intensive farming using the most modern methods is necessary to reduce these effects caused largely by extensive low-yield practices in a country where available land is extremely limited. It is proposed that the government augment its present policy of reforestation and take other steps to conserve the environment and to reduce siltation and erosion. Whereas the construction of coastal embankments to protect human life and property is necessary, much greater efforts should be taken to realize these engineering projects with minimum damage to the environment. A proper coastal zone management policy requires increased coordination among the numerous governmental agencies and the collection of sufficient reliable data on the ecosystem. (Author's abstract)
W89-13048

POPULATION DYNAMICS AND DISTRIBUTION OF JUVENILE VOBLA, RUTILUS RUTILUS, BREAM, ABRAMIS BRAMA, AND ZANDER, STIZOSTEDION LUCIOPERCA, IN THE NORTHERN CASPIAN.
Kaspiiskii Nauchno-Issledovatel'skii Inst. Rybnogo Khozyaistva, Astrakhan (USSR).
L. A. Belogolova.
Journal of Ichthyology JITHAZ, Vol. 28, No. 3, p 14-25, 1989. 5 fig, 6 tab, 22 ref. Originally published in Voprosy Ikhtiologii, No. 6, pp. 924-935, 1987.

Descriptors: *Flow control, *Volga River, *Caspian Sea, *Fish populations, *Regulated flow, Popu-

lation dynamics, Floods, Fish migration, Deltas, Saline water, Shallow water.

Results on the yield of juvenile vobla, bream, and zander in the Northern Caspian in the periods of natural and regulated flow of the Volga River are reported. The significance of the hydrological regime of the spring flood from the yield of these species in the period of regulated flow as well as on the conditions of their feeding in the sea are demonstrated. The foraging area of young semimigratory fishes in Northern Caspian before and after regulation of the Volga stream was determined by population abundance level and volume of spring floods. In the years of low abundance, the young of these species form large groups in the shallow water zone of the sea, and occupy deeper parts of the sea in the years of high abundance. The migration paths of juvenile vobla under the conditions of regulated flow did not change. Most juvenile bream, after migrating from the eastern part of the delta, move in a northwestern direction toward Lake Chechen. (Author's abstract)
W89-13192

USE OF STABLE CARBON AND NITROGEN ISOTOPES TO TRACE THE LARVAL STRIPED BASS FOOD CHAIN IN THE SACRAMENTO-SAN JOAQUIN ESTUARY, CALIFORNIA, APRIL TO SEPTEMBER 1985.
Geological Survey, Sacramento, CA. Water Resources Div.
W. Rast, and J. E. Sutton.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $10.95, microfiche $4.00. USGS Water-Resources Investigations Report 88-4164, February 1989. 62p, 17 fig, 19 tab, 24 ref.

Descriptors: *Tracers, *Bass, *Sacramento-San Joaquin Estuary, *California, *Estuaries, Stable isotopes, Food chains, Trophic level, Nitrogen, Energy flux, Phytoplankton, Detritus, Zooplankton, Shrimp.

To assess one potential cause for the decline of the striped bass fishery in the Sacramento-San Joaquin Estuary, stable carbon and nitrogen isotope ratios were used to examine the trophic structures of the larval striped bass food chain, and to trace the flux of these elements through the food chain components. Study results generally confirm a food chain consisting of the elements, phytoplankton/detritus-->zooplankton/Neomysis shrimp-->larval striped bass. The stable isotope ratios generally become more positive as one progresses from the lower to the higher trophic level food chain components, and no unusual trophic structure was found in the food chain. However, the data indicate an unidentified consumer organism occupying an intermediate position between the lower and higher trophic levels of the larval striped bass food chain. Based on expected trophic interactions, this unidentified consumer would have a stable carbon isotope ratio of about 28/mil and a stable nitrogen isotope ratio of about 8/mi. Three possible feeding stages for larval striped bass also were identified, based on their lengths. The smallest length fish seem to subsist on their yolk sac remnants, and the largest length fish subsist on Neomysis shrimp and zooplankton. The intermediate-length fish represent a transition stage between primary food sources and/or use of a mixture of food sources. (USGS)
W89-13349

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

REALISING THE VALUE OF RESEARCH.
North West Water Authority, Warrington (England).
R. F. Critchley, V. P. Anspoks, F. E. Greaves, and M. G. Matthews.
Water Science and Technology WSTED4, Vol. 21, No. 8/9, p 1037-1044, 1989. 1 fig, 2 ref.

Descriptors: *Research priorities, *Benefits, *Communication, On-site investigations, Management planning, Foreign research.

The aim of any research or development activity is to acquire benefit. There are many pitfalls preventing correct targeting of effort into the most beneficial areas or preventing full implementation of a proven idea. The following points are important: (1) active communication through reports, newsletters and seminars, (2) stimulating demand through identifying key sites and carrying out on-site demonstrations and, (3) providing adequate resources to enable take-up. The achievement of benefits from research is not automatic on successful completion of an investigation. Extensive effort is required to provide the conditions for effective implementation of a new proven idea or process. Active communication with potential users is required not just to demonstrate the merits of the innovation, but also to explain its relevance to identified sites. The ultimate and most effective form of demonstration is by on-site trial using, for example, a mobile demonstration unit. (Miller-PTT)
W89-13079

9D. Grants, Contracts, and Research Act Allotments

EVALUATION OF THE STATE WATER RESOURCES RESEARCH INSTITUTES.
Geological Survey, Reston, VA. Water Resources Div.
M. O. Ertel.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-85, 1988. 28p, 4 append.

Descriptors: *Water Research Institutes, *Evaluation, *Research, Education, Training, Universities, Funding, Federal appropriations, Information transfer.

Water-Resources Research Institutes, as authorized by the Water Resources Research Act of 1984 (Public Law 98-242), are located in each State and in the District of Columbia, Guam, Puerto Rico, and the Virgin Islands. Public Law 98-242 mandated an on-site evaluation of each of these institutes; the results of these evaluations, which were conducted between September 1985 and June 1987, are summarized. The evaluation teams found that all 54 institutes are meeting the basic objectives of the authorizing legislation; 48 institutes were determined to be fully eligible for continued support in the national interest under the provisions of Public Law 98-242. Deficiencies identified in the programs of six institutes resulted in those institutes being placed on probation for 1 year to allow time for corrective actions to be taken. The most general conclusion that can be drawn from the evaluations is that the institutes as a whole are using their Federal funds in a cost-effective manner by marshaling the resources of the academic community to address important problems identified in cooperation with water interests in the States. Thus, they are serving the national interest as envisioned by the authorizing legislation. (USGS)
W89-13012

FISCAL YEAR 1987 PROGRAM REPORT UTAH WATER RESEARCH LABORATORY.
Utah Water Research Lab., Logan.
L. D. James.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-205181/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G1593-01, August 1988. 27p. Project USGS G1593-01.

Descriptors: *Water Research Institutes, *Utah, *Research, *Training, *Information transfer, Education, Projects.

Within the $2.7 million research program underway in 14 program areas at the Utah Water Research Laboratory, two programs are augmented with USGS funds through the Utah Center for Water Resources Research. Both involve interdisciplinary interaction. One area examines fundamental meteorologic and surface and groundwater processes in closed desert basins in order to be better able to manage the limited water and sparsely developed land resources around desert playas. The second seeks deeper understanding of the fundamental chemical and biological processes for protecting water supplies from hazardous wastes. The present major application is the threat to groundwater from toxic organic chemicals (largely petroleum-related in Utah). During fiscal year 1987, UCWRR supported three projects on desert basin hydrology and two on protecting groundwater supplies from organic chemicals. The first project on desert hydrology used developed instrumentation to measure precipitation and evaporation patterns across a transect of a remote desert valley and defined grass lands between the mountains and the playa as the primary area of evaporation. The water stored in the playas is unable to evaporate through the salt crust and remains stored underground. The second project modeled subsurface flow from recharge areas near the mountains to discharge onto these grassy lands or move along density gradients upwelling as springs near the borders of the playas. The third project on desert hydrology explores soil crusting and underlying vesicular horizons in a search for ways for promoting more rapid recovery after site disturbances. One project on groundwater quality protection is carrying out laboratory and field evaluations of a variety of soil vapor phase monitoring techniques that could be used for detection of volatile compounds migrating from surface and subsurface releases of hazardous substances under a variety of soil/aquifer conditions. The second is developing methods for estimating the partitioning behavior of organic contaminants in soil waters, and air from their molecular structure in order to reduce the laboratory work required in parameter estimation for transport modeling. (James-UT, WRL)
W89-13322

FISCAL YEAR 1987 PROGRAM REPORT (NEW YORK STATE WATER RESOURCES INSTITUTE).
New York State Water Resources Research Inst., Ithaca.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-200083/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G1438-01, July 1988. 11p. Contract 14-08-0001-G1438. Project USGS G1438-01.

Descriptors: *Water Research Institutes, *Research, *Information transfer, *Training, *New York, Education, Projects.

New York's FY87 annual program of water research and technology focused on inexpensive wastewater and landfill leachate treatment methods applicable particularly in small communities. The Root Zone Method, growing in popularity in Europe, was chosen for scruntiny. The Root Zone Method was studied in two ways: (1) by receiving design and operational data from a spectrum of existing installations in Europe and North America; and (2) by conducting laboratory experiments to study basic processes and parameters which govern the effectiveness of contaminant removal. The principal questions are: What are the best organic and hydraulic loading rates. What are the hydraulic pathways and rates of flow under various design and operating conditions. What are the processes and rates of contaminant removal. This work is now being incorporated into a large effort for which additional support will be provided by the N.Y.S Energy Research and Development Authority and the Town of Fenton, NY. This broader effort will investigate the use of root zone technique for treating landfill leachate. (Porter-Cornell U.)
W89-13323

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

WATER-RESOURCES ACTIVITIES IN UTAH BY THE U.S. GEOLOGICAL SURVEY, JULY 1, 1987, TO SEPTEMBER 30, 1988.
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-13326

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN NEW MEXICO--FISCAL YEAR 1988.
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-13367

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN PENNSYLVANIA, 1988-89.
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-13368

BIBLIOGRAPHY OF WATER-RESOURCES INVESTIGATIONS REPORTS PUBLISHED BY THE U. S. GEOLOGICAL SURVEY FROM 1971 THROUGH 1982.
Geological Survey, Reston, VA. Water Resources Div.
S. A. Edmonds.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-69, June 1989. 47p.

Descriptors: *Bibliographies, *Groundwater data, *Surface water, *Water quality, *Groundwater availability, *Publications, Groundwater quality, Surface water availability, Groundwater pollution.

This report contains a cross-referenced listing of 971 Water-Resources Investigations reports (WRIR's) published by the U.S. Geological Survey from 1971 through 1982. The reports are listed by WRIR number. Most requests for WRIR's generally are by WRIR number; however, the Survey's annual catalog, 'Publications of the U.S. Geological Survey (year),' indexes WRIR's under the National Technical Information Service number, with the WRIR appearing only at the end of the citation within the index. Additionally, a few WRIR's have been listed in the index without any reference to their WRIR number; and some WRIR's appeared only in the discontinued Water Resources Investigations folder series. This report lists WRIR's in sequential order to assist the readership in locating a particular publication. (USGS)
W89-13380

10D. Specialized Information Center Services

PRACTICAL IMPLEMENTATION OF A HYDROBIOLOGICAL INFORMATION SYSTEM ON A COMPUTER (PRAKTICHESKAIA REALIZATSIIA NA GIOROBIOLOGICHESKOI INFORMATSIONNOI SISTEMY).
Institut Ekologicheskoi Toksikologii, Baikal'skogo Filiala VNPO Bumprom.
O. M. Kozhova, and E. V. Peskova.
Gidrobiologicheski Zhurnal GBZUAM, Vol. 24, No. 5, p 3-9, 1988. 4 ref. English summary.

Descriptors: *Information systems, *Computers, *Lake Baikal, Hydrobiology, Computer programs, Monitoring, Data processing.

A description of the hardware and software used for a hydrobiological information system covers all the stages of its development: from the original idea to its practical realization. Introduction of such an automated system of information collection storage and processing is of great significance for optimizing monitoring of Lake Baikal. (Author's abstract)
W89-12720

10F. Preparation Of Reviews

INORGANICS.
Massachusetts Univ., Amherst. Graduate School.
For primary bibliographic entry see Field 5A.
W89-12502

ORGANICS.
Tennessee Technological Univ., Cookeville.
For primary bibliographic entry see Field 5A.
W89-12503

WATER CHARACTERISTICS.
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W89-12504

CONTINUOUS MONITORING, AUTOMATED ANALYSIS, AND SAMPLING PROCEDURES.
Oak Ridge National Lab., TN. Chemical Technology Div.
For primary bibliographic entry see Field 7B.
W89-12505

WASTEWATER COLLECTION.
Geo-Marine, Inc., Plano, TX.
For primary bibliographic entry see Field 5D.
W89-12506

WASTEWATER TREATMENT--PHYSICAL AND CHEMICAL METHODS.
Maryland Univ., College Park.
For primary bibliographic entry see Field 5D.
W89-12507

ACTIVATED SLUDGE.
CH2M Hill, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5D.
W89-12508

BIOLOGICAL FIXED-FILM SYSTEMS.
New Hampshire Univ., Durham. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-12509

LAGOONS AND POND.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-12510

ANAEROBIC PROCESSES.
Massachusetts Univ., Amherst. Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W89-12511

SLUDGE TREATMENT, UTILIZATION, AND DISPOSAL.
Metcalf and Eddy, Inc., Wakefield, MA.
For primary bibliographic entry see Field 5D.
W89-12512

ON-SITE ALTERNATIVES FOR TREATMENT AND DISPOSAL.
ENSR Contructors, Acton, MA.
For primary bibliographic entry see Field 5D.
W89-12513

DISINFECTION.
University of South Florida, Tampa. Coll. of Public Health.
For primary bibliographic entry see Field 5D.
W89-12514

TREATMENT PLANT MANAGEMENT, OPERATION, AND MAINTENANCE.
Baker/TSA, Inc., Coraopolis, PA.
For primary bibliographic entry see Field 5D.
W89-12515

WATER RECLAMATION AND REUSE.
California State Water Resources Control Board, Sacramento.
For primary bibliographic entry see Field 3C.
W89-12516

LAND APPLICATION OF WASTEWATER.
Dames and Moore, Atlanta, GA.
For primary bibliographic entry see Field 5D.
W89-12517

URBAN RUNOFF AND COMBINED SEWER OVERFLOW.
Calocerinos and Spina, Liverpool, NY.
For primary bibliographic entry see Field 5B.
W89-12518

HEALTH EFFECTS ASSOCIATED WITH WASTEWATER TREATMENT, DISPOSAL, AND REUSE.
Alberta Univ., Edmonton. Div. of Health Services Administration.
For primary bibliographic entry see Field 5C.
W89-12519

MEAT, FISH, AND POULTRY PROCESSING WASTES.
Battelle Memorial Inst., Columbus, OH.
For primary bibliographic entry see Field 5D.
W89-12520

FRUIT, GRAIN, AND VEGETABLE WASTES.
Brigham Young Univ., Provo, UT. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-12521

FERMENTATION INDUSTRY.
Alabama Univ. in Birmingham. School of Public Health.
For primary bibliographic entry see Field 5D.
W89-12522

DAIRY WASTES.
Brown (Floyd) Associates, Inc., Marion, OH.
For primary bibliographic entry see Field 5D.
W89-12523

AGRICULTURAL WASTES.
For primary bibliographic entry see Field 5D.
W89-12524

TEXTILE WASTES.
ENSR Contructors, Acton, MA.
For primary bibliographic entry see Field 5D.
W89-12525

PULP AND PAPER EFFLUENT MANAGEMENT.
Western Michigan Univ., Kalamazoo.
For primary bibliographic entry see Field 5D.
W89-12526

COAL AND COAL MINE DRAINAGE.
Olem Associates, Washington, DC.
For primary bibliographic entry see Field 5C.
W89-12527

PETROLEUM PROCESSING AND SYNTHETIC FUELS.
Stover and Bentley, Inc., Stillwater, OK.
For primary bibliographic entry see Field 5D.
W89-12528

POWER INDUSTRY WASTES.
Donohue and Associates, Inc., Sheboygan, WI.
For primary bibliographic entry see Field 5D.
W89-12529

METAL FINISHING AND PROCESSING.
CH2M/Hill, Reston, VA.
For primary bibliographic entry see Field 5D.
W89-12530

RADIOACTIVE WASTES.
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W89-12531

HAZARDOUS AND SOLID WASTES.
Dames and Moore, Atlanta, GA.
For primary bibliographic entry see Field 5E.
W89-12532

NONPOINT SOURCES.
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W89-12533

MIXING AND TRANSPORT.
For primary bibliographic entry see Field 5B.
W89-12534

LAKE AND RESERVOIR MANAGEMENT.
Environmental Protection Agency, Dallas, TX. Region VI.
For primary bibliographic entry see Field 2H.
W89-12535

DISSOLVED OXYGEN IN STEAMS AND RESERVOIRS.
Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 5C.
W89-12536

GROUNDWATER.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W89-12537

THERMAL EFFECTS.
Federated Dept. Stores and Allied Stores Corporation, 7 West Seventh Street, Cincinnati, OH 45202.
For primary bibliographic entry see Field 5C.
W89-12538

FATE OF POLLUTANTS.
Colorado Univ. at Boulder. Center for Advanced Decison Support for Water and Environmental Systems.
For primary bibliographic entry see Field 5B.
W89-12539

EFFECTS OF POLLUTION ON FRESHWATER ORGANISMS.
Environmental Monitoring Systems Lab., Cincinnati, OH. Aquatic Biology Branch.
For primary bibliographic entry see Field 5C.
W89-12540

EFFECTS ON SALTWATER ORGANISMS.
California State Univ., Long Beach. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W89-12541

AQUATIC SEDIMENTS.
URS Consultants, Inc., Cleveland, OH. Planning and Environmental Services Div.
For primary bibliographic entry see Field 5A.
W89-12542

SUBSTRATE ASSOCIATED MICROFAUNA.
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 2H.
W89-12543

HUMAN HEALTH EFFECTS ASSAYS.
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
For primary bibliographic entry see Field 5C.
W89-12544

EFFECTS OF CHEMICALS ON MICROORGANISMS.
Environmental Protection Agency, Washington, DC. Office of Toxic Substances.
For primary bibliographic entry see Field 5C.
W89-12545

DETECTION AND OCCURRENCE OF WATERBORNE BACTERIAL AND VIRAL PATHOGENS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W89-12546

ACIDIC DEPOSITION.
Connecticut Univ., Storrs. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W89-12547

BIOMONITORING.
Eckenfelder, Inc., Nashville, TN.
For primary bibliographic entry see Field 5A.
W89-12548

NITRATE LEACHING UNDER IRRIGATION IN THE UNITED STATES.
Delaware Univ., Newark. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W89-12626

RESEARCH IMPERATIVES FOR IRRIGATION SCIENCE.
Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant Physiology.
For primary bibliographic entry see Field 3F.
W89-12636

CADMIUM IN MYTILUS SPP.: WORLDWIDE SURVEY AND RELATIONSHIP BETWEEN SEAWATER AND MUSSEL CONTENT.
Institut Francais de Recherche pour l'Exploitation de la Mer, Nantes.
For primary bibliographic entry see Field 5B.
W89-13041

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W89-12541	5C	W89-12625	5B	W89-12709	5D	W89-12793	5A
W89-12542	5A	W89-12626	5B	W89-12710	2H	W89-12794	5A
W89-12543	2H	W89-12627	5F	W89-12711	5B	W89-12795	5A
W89-12544	5C	W89-12628	8A	W89-12712	2F	W89-12796	5D
W89-12545	5C	W89-12629	2B	W89-12713	2B	W89-12797	5F
W89-12546	5A	W89-12630	2H	W89-12714	5F	W89-12798	5E
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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

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9 MANPOWER, GRANTS, AND FACILITIES

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ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

1989 Price Schedules for the United States, Canada, and Mexico

These prices are for customers in the United States, Canada, and Mexico; other customers, write for price list PR-360-4.

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A99 ..... *	E10 ..... 31.00		D10 475	T10 1,025
	E11 ..... 33.50		D11 525	T11 1,125
	E12 ..... 36.50		D12 575	T12 1,225
	E13 ..... 39.00		D13 625	T13 1,325
	E14 ..... 42.50		D14 675	T14 1,425
	E15 ..... 46.00		D15 725	T15 1,525
Published Searches & Special Directories	E16 ..... 50.50		D16 775	T16 1,625
	E17 ..... 54.50		D17 825	T17 1,725
	E18 ..... 59.00		D18 875	T18 1,825
	E19 ..... 65.50		D19 925	T19 1,925
N01 ..... $55.00	E20 ..... 76.00		D99 ..... *	T99 ..... *
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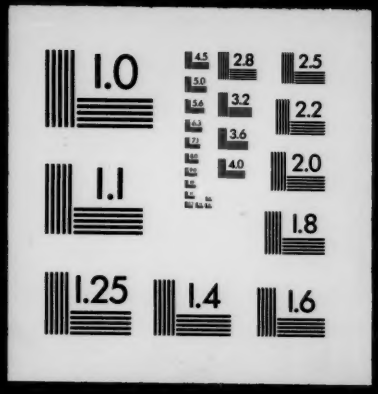
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2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
7.1
8.0
9.0
10.0